

A
SYSTEM
OF
PRACTICAL MEDICINE

COMPRISED IN
A SERIES OF ORIGINAL DISSERTATIONS.

ARRANGED AND EDITED BY
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WITH NOTES AND ADDITIONS,

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NERVOUS DISEASES,

(CONTINUED.)

ORGANS OF RESPIRATION,

CIRCULATION,

AND

ARTERIES.

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SPINAL IRRITATION.

Explanation of the term spinal irritation.—Various anomalous symptoms.—Predisposing causes.—Exciting causes.—Nature.—Diagnosis.—Prognosis.—Duration.—Treatment.

THIS term has been used to designate an affection usually characterized by pain in the back, either induced or increased by pressure of the spinous processes of the vertebræ, accompanied by neuralgic and hysteric symptoms of a nature so variable as to simulate almost every form of disease to which the body is liable. Spinal irritation ought to be considered rather as an effect of disease, than as a malady *sui generis*, but as the subject is of the highest practical importance, it is proper to direct attention to it by giving a detail of its phenomena in this place.

Various forms of this affection have been described in cases of neuralgia, and termed *thoracic*, *epigastric*, or *intestinal*, according to the locality of the pain, &c., practical writers, especially Nicod (*Nouv. Journ. de Méd. Chir. et Pharm.* tom. iii. p. 247., 1818,) Teale (*On Neuralgic Diseases*), and Brown (*Glas. Med. Journ.*, 1828.) They have been described in connexion with hysteria by Tate (*Treatise on Hysteria*.) The disorder has been called spinal irritation by Parrish (*Amer. Journ. of the Med. Sciences*, 1832,) Darwell (*Midland Med. and Surg. Rep.* 1829,) Griffin (*On Functional Affections of the Spinal Cord, &c.*), Entz (*Rust's Magazin für die Gesammelte Heilkunde*, 1836,) and Ollivier (*Sur la Moelle Epinière*, 3d edit.) The term spinal irritation, although objectionable in many points of view, has been generally received, and is therefore retained in this place.

Symptoms.—When it is remembered that the spinal cord furnishes directly or indirectly nerves to every organ in the body, the numerous symptoms which may be produced by the increased, diminished, or perverted functions of one or more of these may be readily imagined. Hence the phenomena this affection presents differ according to the extent, seat, and intensity of this irritation, and are so greatly diversified as to prevent the possibility of giving a description which would be applicable even to the majority of cases. The only means we can think of for conveying a general idea of this disorder, is by referring to the different forms of hysteria, neuralgia, and chronic rheumatism. A combination of the symptoms occasionally presented by all three, constitutes spinal irritation.

The only constant symptom is more or less pain on pressing the spinous processes of the vertebræ. It may be confined to one spot, or be more or less diffused over the spinal column, pointing out the extent of the spinal irritation. In many cases the patient is unconscious of any thing wrong in the back, often denies the existence of pain in that situation, and refers all the uneasiness to the ultimate distribution of the nerves arising from the part. Sometimes there is a dull constant pain, which is overlooked, and thought to be wholly unconnected with the local complaint. When pressure, however, is made on the affected part, the pain in the back is increased, and not unfrequently the patient starts as if an electric shock had been received, or falls into a state of syncope. The seat of pain generally corresponds with the origin of the nerves ramifying on the organs, or portion of the surface complained of, although in some instances, as stated by

Griffin, the morbid changes in the cord appear somewhat more extensive than the external tenderness. The local pain is often produced or increased by lifting heavy weights, or twisting the body, and has often been excited by jerks or slight concussions when walking.*

In conjunction with the spinal tenderness there may be neuralgic pains, more or less diffuse, over different parts of the surface, diminished sensibility, convulsions or paralysis; and as the functions of the different viscera and organs of the body are often impaired, various diseases are simulated. Thus women suffer neuralgic pains sometimes in the right, but more commonly on the left side, beneath the mamma; sometimes, again, the breast itself is more especially affected, constituting the irritable mamma of Sir A. Cooper. In other cases there is a feeling of numbness, as pointed out by Dr. Brown of Glasgow, or of constriction round the thorax, as if a walnut or other hard substance were pressed within a tight belt. Occasionally the affection commences with pain in the occiput, and rheumatic sensations in the neck and shoulders, several cases of which are given by Mr. Teale of Leeds. At other times, instead of neuralgic pains, there is a sense of numbness in the hands or feet, extending more or less over the extremities. We have seen a case where the only symptom was excessive coldness in the hands and fingers, that often amounted to actual pain, and prevented the individual from sewing, and carrying on her usual employments. If the spinal irritation be more severe, the internal organs participate, and the symptoms produced vary according to the portion of the cord that is affected.

When the spinal tenderness is confined to the cervical portion, there may be headach; loss of voice; neuralgic pains in the face and gums; trismus; various disorders of vision, as ocular spectra, *muscæ volantes*, night blindness, &c.; more or less deafness, or confused sounds in the ears; diminished or perverted sensation of taste and smell; dysphagia; paralysis of the tongue; sickness; vomiting; loss of appetite, inordinate hunger or thirst; pain at the stomach; pyrosis; difficult breathing, cough, irregularity of the pulse; palpitations; disposition to syncope; paralysis of one or both arms, sometimes confined to the fingers, hands, arms, or shoulders; increased sensibility or numbness in those situations; pricking, formication, &c. Although these symptoms may have coincided at different times with cervical tenderness, it is evident that many of them, more particularly such as affect the special senses, arise from irritation of the cranial portion of the cord. When vertigo or delirium is present in such cases, it is probable that the brain itself is more or less affected. When the irritation is in the dorsal region, the palpitations of the heart and dyspnoea are more marked; there is sometimes dry cough; pleurodynia; pain under the clavicles, in the shoulders and superior extremities; sense of constriction in the thorax, often like a tight band; neuralgic pains in the side; diminished sensibility in the breast and epigastrium; more or less derangement in the digestive organs, &c. When it is situated in the lumbar portion, the symptoms are, pain in the parietes of the abdomen, hypogastrium, loins, and genito-urinary apparatus; symptoms resembling gravel in the kidneys, ureters, or bladder; irritable uterus; cramps and increased sensibility, or palsy more or less complete in the inferior extremities.

When the spinal irritation is more diffused, there is an admixture or combination of the above symptoms. Hence the occasional difficulty experienced in

* The pain is not always present; at least not in all cases in which applications to the spinous processes of vertebræ, nearly corresponding with the organs which are the seat of functional disorder or of neuralgic pains, are more beneficial than any other treatment. This is often the case with neuralgic pains near the left nipple, whether they occur in children or in adults, and with some forms of dyspepsia. These neuralgic pains in males frequently follow intermittent fever. The success of the applications is, however, much less certain in these cases than in those in which the vertebræ are tender on pressure; in the latter case immediate benefit may confidently be expected from cupping or leeching on the tender part of the spine, and as the soreness disappears the corresponding organs are generally relieved.

tracing the various undefined symptoms to their true source. Cases of angina pectoris, asthma, different forms of neuralgia and hysteria, spasmodic croup, convulsions, hydrophobia, epilepsy, tetanus, chorea, paralysis, spasmodic colic, diarrhœa, cholera, irritable bladder, &c., are recorded by Griffin, all of which have been connected with the spinal irritation, and disappeared on its departure. It often happens that the spinal tenderness shifts its position, when the other symptoms change also. A remarkable case is detailed by Griffin of a young lady, in whom the symptoms successively assumed the appearances of organic lesion of the lungs, heart, and abdominal viscera, together with an endless variety of other complaints of a neuralgic, asthmatic, epileptic, cataleptic, and paralytic nature. Indeed the singular changes, the disease undergoes, render it impossible to obtain a perfect knowledge of its numerous forms, without studying in detail the extraordinary cases which have been recorded of it.

Causes. Women are much more predisposed to this complaint than men, and young girls more than married women. Of 248 cases given by Griffin, 26 were males, 49 married women, and 73 girls. In a table of 154 cases (given in the same work,) we have determined that one occurred at the age of 4 years, that there were 7 between the age of 10 and 15; 18 between 15 and 20; 31 between 20 and 25; 15 between 25 and 30; 17 between 30 and 35; 18 between 35 and 40; 14 between 40 and 45; 12 between 45 and 50; 7 between 50 and 55; 3 between 55 and 60; 5 between 60 and 65; and 6 whose ages are not recorded.

This disorder, therefore, is most frequent between the ages of fifteen and fifty—the menstrual period of women. Spinal irritation has been observed in every habit and constitution—in the full and plethoric, as well as in those who are spare and delicate. In almost all, however, who have been affected, somewhat of the nervous temperament has been remarked, or at all events a peculiar excitability of the system. The most common *exciting* causes are uterine disorder; exposure to cold and moisture; dyspepsia, worms, and other sources of irritation in the alimentary canal; affections of the liver, mental emotions; erysipelatous, rheumatic and eruptive fevers; local injuries, &c.

Nature. As spinal irritation uncomplicated with other disease rarely terminates fatally, the exact anatomical characters of this affection are unknown. There can be little doubt, however, that in the majority of cases the symptoms are referrible to a state of congestion of the spinal cord or its investing membranes. Ludwig and J. P. Frank have alluded to the effects of spinal congestion, and the anatomical circumstances which favour its occurrence. The latter, in particular, has pointed out the absence of valves in the spinal vessels, together with their peculiar distribution on the surface of the cord. Their anatomical structure and arrangement render them peculiarly liable to congestion, as the venous blood must ascend in opposition to gravity. They are also equally pressed on by the cerebro-spinal fluid in a state of health, and any cause which tends to increase or diminish its normal quantity, may readily be conceived to produce venous congestion. Hence derangements in the menstrual functions, and the various causes which have been mentioned, frequently occasion dorsal and lumbar pains, with other symptoms of spinal irritation. The vessels being principally superficial, unless very much dilated, occasion only partial pressure, and consequently increased action followed by the principal phenomena of this affection, viz. neuralgic pains. That motion is not so commonly increased or diminished, may be attributed to the relation of the cord with the osseous walls which surround it, as pointed out by Ollivier, for the anterior columns are almost immediately applied to the bone, while the posterior are five or six lines distant from it. Independent of any positive evidence, therefore, it may be said that the theory of congestion is fully capable of explaining the phenomena, and is the morbid condition which of all others we should expect to follow the known causes of the disorder. On the other hand we cannot, with some authors, suppose it to be chronic inflammation, for the changeable nature of the affection, and its sudden appearance and disappearance, are opposed to such an opinion. With regard to the spinal ten-

derness, it has been well pointed out by Dr. Locock *Edin. Med. and Surg. Journ.*, No. 136.) that "an inspection of the vertebral column in an anatomical subject will show at once how impossible it is to press the cord or the nerves going from it, in the slightest degree." We cannot think with him, however, that "tenderness of the spinal marrow is a sign of little value," as numerous cases prove that there is a connexion between the situation of the local tenderness and other symptoms, while local treatment has dissipated the disorder, when remedies directed to the removal of its more remote effects have failed. No doubt the spinal irritation is in itself only a symptom, although one which indicates with tolerable certainty the origin of the malady, and as our pathological knowledge improves, there is every reason to suppose that this view of its pathology will be generally admitted.

Diagnosis. It is remarked by the Messrs. Griffin, that there does not appear to be any complaint to which the human frame is liable, whether inflammatory or otherwise, which may not occasionally be imitated in disturbed states of the cord, and hence it is a prolific source of those complaints called hysterical or nervous. The same authors have given the following diagnostic symptoms, by which it may be distinguished from organic disease:—1. The pain or disorder of any particular organ being altogether out of proportion to the constitutional disturbance. 2. The complaints, whatever they may be, usually relieved by the recumbent position, always increased by lifting weights, bending, stooping, or twisting the spine; and among the poorer classes, often consequent to the labour of carrying heavy loads, as in drawing water, manure, &c. 3. The existence of tenderness at that part of the spine which corresponds with the suffering organ. 4. The disposition to a sudden transference of the diseased action from one organ or part to another, or the occurrence of hysterical symptoms in affections apparently acute. (*Opus. cit.* p. 214.) Attention to the four circumstances above enumerated, will generally enable the practitioner to identify this disorder. It may readily be mistaken for disease of the vertebral bones, as there is not unfrequently an apparent prominence of the vertebrae, where the tenderness is felt. As such an error may lead to very distressing consequences, it will be well to enumerate the circumstances which distinguish the one from the other. In vertebral disease the prominence is angular, and depends on displacement of the bones or curvature: in spinal irritation it is round, and is occasioned by slight swelling of the ligaments or coverings of the spine: in diseased vertebra there are seldom hysterical symptoms in young females, whereas they are common in spinal irritation. Disease of the vertebra is most common in young persons of a strumous constitution, whereas spinal irritation is most frequent in adults. Lastly, complete paralysis is common in vertebral disease, rare in spinal irritation, and in the latter, the general health is not so much affected.

Prognosis. The prognosis in spinal irritation is always favourable, as there is every reason to believe that the mere state of irritation uncomplicated with a more serious morbid lesion has never proved fatal. When there is any other coexisting disease, the prognosis of course is the same as that of the particular affection with which the spinal irritation is complicated.

The *duration* of the symptoms is very variable, and may continue from a single day to three or four years. A case is given by Griffin where it continued four years and a half; according to whose experience, a quick and irritable pulse and furred tongue are indications of an obstinate and troublesome attack.

Treatment.—The various and often contradictory symptoms induced by spinal irritation, render its diagnosis and treatment difficult and uncertain. Numerous facts, indeed, attest that individuals have long laboured under rheumatic, neuralgic, and hysterical complaints, during which they have suffered the greatest tortures, although they have been relieved in a few days by treatment directed locally to the spine. Whatever difficulties, therefore, may exist in drawing a line of demarcation between the effects of spinal irritation and numerous other disorders, notwithstanding the obscurity that rests on the precise nature of the morbid change

which produces it, the great practical utility to be derived from its study is unquestioned. So fully are we impressed with its importance, that we consider that in all cases of neuralgia, rheumatism, and hysteria, the spine should be examined; while, perhaps, there is scarcely a functional disorder to which the young female is liable, which may not occasionally be found connected with spinal irritation. We have often had an opportunity of observing the manner in which numerous disorders have been traced to this source, and feel assured that if practitioners in general would pay greater attention to this complication, many of the extraordinary and anomalous cases which are at present the cause of great embarrassment in practice, might terminate in the speedy relief of the patient, and increased credit to the physician.

It must not be supposed, however, that the difficulty terminates, even when the disease is found to be connected with spinal irritation, for experience has demonstrated that this is in itself not unfrequently a secondary effect, produced by the disordered functions of other organs. The first object of the medical attendant, therefore, should be to determine whether the affection is idiopathic or sympathetic, acute or chronic.

When the disorder is idiopathic, our attention must be directed to the restoration of the general health of the patient, and an antiphlogistic or tonic line of treatment determined on according to the circumstances of the case. Accordingly, the application of leeches, or cupping over the spine where there is tenderness, or stimulants and counter-irritants, should be employed, according to the general strength of the patient, and the acute or chronic nature of the disease. In many cases the loss of blood by leeches has been sufficient to remove the symptoms; in others counter-irritation, as by blistering or the tartar emetic ointment, has succeeded.* The latter is particularly recommended by Mr. Tate, and may be used with every hope of benefit. But when the affection is sympathetic, as is generally the case, in addition to the above means, the origin of the malady is to be anxiously sought after, and remedies administered which are calculated to remove it. By far the most common cause in females is derangement in the menstrual discharge, and, under such circumstances, the endeavours of the medical attendant should be directed to promote the due performance of this function. If there be irritation in, or improper action of, the digestive or biliary organs, the disordered state should be combated by appropriate remedies. Every medicine employed should have reference to the state of the system, and constitutional powers of the individual, and a low or nourishing diet prescribed accordingly. In persons of an irritable temperament, change of air, exercise, congenial society, and all methods of distraction, should be recommended. In chronic cases, the disease is often very intractable, but if it have been previously treated in an injudicious manner, much may be effected by the above means. If there be much pain or watchfulness, anodynes are useful: hyoscyamus and belladonna should be preferred, opium often increases the irritability. In other respects the treatment should be conducted on the principles laid down under HYSTERIA and NEURALGIA, with which disorders spinal irritation is almost inseparably connected.

* There are milder counter-irritants which are adapted to many cases. Such as the repeated application of mustard poultices, every night or every second night they should be made much diluted that they may be borne for a long time, or frictions with croton oil, or a stimulating liniment made with the oil of turpentine, olive oil, and some stimulating essential oil also act very well. An ounce of the oil of turpentine, two of olive oil, a drachm of croton oil, and half a drachm of the oil of cinnamon, is a good combination. When the tenderness is extreme it is well to use a little laudanum and olive oil, before applying an irritating liniment.

SPINAL MENINGITIS.

Definition.—Symptoms,—of the acute form—of the chronic form.—Causes.—Anatomical characters.—Nature.—Diagnosis.—Prognosis.—Treatment.

INFLAMMATION in the membranes investing the spinal cord is an affection which exists very rarely without accompanying disease in the substance of the cord, or in the membranes of the brain. Occasionally, however, it occurs alone, and appears to be as readily distinguished from inflammation of the substance of the cord (myelitis) as cerebral meningitis is from cerebritis. Observation has shown that there are no signs by which it is possible to distinguish inflammation of the membranes of the spinal cord, that is, inflammation of the dura mater from that of the pia mater, although Professor Albers of Bonn has attempted to do so. (*Journal für Chirurgie und Augenheilkunde*, vol. xix, chap. 3.) The symptoms, therefore, must be considered common to inflammation of both these membranes.

Symptoms. Acute spinal meningitis generally commences with sensation of weight and fatigue in the limbs, often attended with constipation, and occasionally with dysuria, or even retention of urine. These symptoms are followed by pain in the back, more or less severe, most commonly in the lumbar region, which is at first of a dull description, but becomes rapidly more acute, and extends to the limbs; the pain is sometimes lancinating, arising from a fixed point in the back; in other cases it is not so concentrated or severe when the patient is at rest, but is greatly increased by the slightest motion, a circumstance that often gives rise to the impression, that the affection is rheumatism. According to Ollivier, the pain is not augmented by pressure; sometimes it is continued; occasionally there are complete remissions, and the patient almost always avoids muscular motion, from the fear of increasing it. On the occurrence of the pain, there is often a sense of constriction in the neck, back, or loins, according as the membrane is inflamed to either of those situations. As the disease advances, there are convulsive contractions of the neck and posterior part of the trunk; sometimes there is complete opisthotonos, or a considerable degree of rigidity in the muscles of the back, in which occasionally those of the limbs participate. These movements may come on without any apparent cause, but they are most frequently excited by change of position. In other instances, there is trismus or convulsions, or rigidity of the extremities, with pain throughout their whole extent. Paralysis of motion is mentioned as a symptom by some authors; but there is every reason to believe that in these cases the cord itself is affected. The respiration is laborious or hurried; the pulse, at first natural, becomes rapid, small, and feeble, while the motions of the heart are strong and frequent: these symptoms are generally accompanied with hot skin, thirst, and loaded urine. When the tetanic spasms are intermittent, there is generally abundant perspiration, which becomes more profuse as the disease advances towards a fatal termination. At a later period, the pulse becomes smaller and more irregular; the tongue and mouth dry; the fæces and urine are passed involuntarily; the dyspnoea is more urgent; and drowsiness, delirium, convulsions, with increase of the tetanic spasms, passing into coma, precede the fatal issue.

The progress of these symptoms is usually rapid, if not checked by proper treatment, although its duration varies according to the intensity and extent of the inflammation. It is generally fatal from the fifth to the fifteenth day. Some cases, however, have been recorded by Ollivier, which have been fatal as early as the fourth, and others which have been prolonged to the twentieth or thirtieth day.

In *chronic* meningitis of the spinal cord, the symptoms are developed more slowly. They consist generally at first of obscure dorsal pains, with a sensation of constraint and fatigue in the limbs; sometimes there is morbidly acute sensibility of the cutaneous surface; occasionally pain in the bowels, which is often so severe as to be considered and treated as the primary disease; sometimes there is palpitation of the heart, with dyspnœa, and other anomalous symptoms, so that the spinal disease is very apt to be overlooked. The pain in the back in some instances becomes suddenly increased, or there are distinct remissions or even intermissions; in others it becomes acute, and the patient is carried off with the same symptoms as characterize the last stage of the acute form just described. In both varieties there is usually more or less rigidity of the limbs, with contraction. Poletti has given a case, where, from contractions of the cervical muscles, the head was drawn forcibly down to the right shoulder six months before death. (*Ann. Univ. de Méd. de Omodei*, Nov. 1825.) M. Ollivier has observed, that eschars on the sacrum are not so common in this as in other spinal diseases of long standing.

Causes. The causes of this affection are often very obscure, and in some cases not discoverable. All mechanical injuries are capable of producing the disease, as fractures and dislocations of the vertebræ; violent blows and contusions on the spine, or concussion from falls on the feet and on the nates: it may also supervene on cerebral meningitis, the inflammation apparently extending to the membranes of the spinal cord. Suppression of the menses, hæmorrhoidal hæmorrhages, and of accustomed discharges; chilliness of the body, and sudden changes of heat and cold, have sometimes been supposed to have occasioned it. Cases are given by Ollivier and Bergamaschi, where it followed violent efforts to lift heavy weights. Lastly, individuals subject to rheumatism have been found predisposed to this disease.

Anatomical characters. After *acute* meningitis of the spinal cord, the membranes are usually injected, the red colour being more or less intense, and principally confined to the pia mater, while the arachnoid is rendered opaque by the thickening of the cellular tissue contiguous to it. No vessels have yet been found in this membrane, and consequently the red appearance it often presents arises from an injection of the tissue below it. These signs of inflammatory action are generally found throughout the whole extent of the spinal cord, although sometimes they are more or less circumscribed or limited to spots, an appearance usually found when inflammation has been the result of mechanical injury to the bones. When the dura mater is laid open, there is often effusion of yellowish white lymph, giving the cord, as pointed out by Ollivier, an appearance of enlargement and density. It is always thicker posteriorly than anteriorly, this thickening being sometimes conjoined with a collection of sero-purulent fluid; occasionally there is effusion of pus, but, as noticed by Ollivier, it is rarely found in the cavity of the arachnoid, but generally between that membrane and the pia mater. J. Frank has shown that dropsy of the cord may result from acute inflammation of its membranes. The dura mater is sometimes injected and more or less thickened. Professor Albers of Bonn has seen it of a cinnabar colour in two cases, accompanied with serous and purulent effusions. (*Mém. cit.*) Ollivier, Lallemand, and Bergamaschi, have found serous fluid accumulated between it and the bones. Constant has observed pus in the same situation. (*Gaz. Méd.*, 1835, p. 74, 75.)

In *chronic* meningitis, besides one or more of the above appearances, there is generally adhesion of the arachnoid to the pia or dura mater, and not unfrequently cartilaginous plates, generally small and numerous, in the arachnoid, between it and the pia mater. It is very rare that any of the above signs of inflammation

are confined to the membranes of the cord in general, they are found likewise in those of the brain, or in the substance of the spinal marrow.

Nature. The symptoms of this affection are readily explained by the morbid appearances discovered after death. The inflammation produces irritation and the symptoms of increased action which follow. Paralysis, when present, is to be attributed to pressure on the spinal cord, which not uncommonly participates in the inflammatory action, constituting meningo-myelitis. (See MYELITIS and HYDRO-RACHIS.)

Diagnosis.—According to Ollivier, inflammation of the meninges is to be distinguished from inflammation of the structure of the cord (myelitis,) by the acute pain in the back, increased by motion only, and by the tetanic rigidity of the muscles, while in the latter (myelitis,) the pain is augmented on pressure, with diminution of sensibility, with more or less paralysis.

Apoplexy of the spinal cord is recognised by the sudden occurrence of vertebral pain, tetanic rigidity, convulsions or paralysis. The pain is increased on pressure, which is not the case in meningitis. In some cases there are no tetanic spasms, the pain is fixed and not liable to remission, while the general sensibility is often diminished.

Cerebral meningitis is distinguished by the headach, delirium, injected countenance, intolerance of light and sounds, intense thirst, and general symptoms of fever. Chronic spinal meningitis is known by the slow progress of the symptoms, the intelligence being unimpaired. In the early stage it is with great difficulty diagnosed from rheumatism, and in many cases it cannot be distinguished until the more urgent symptoms appear. Its principal character is tetanic rigidity, whereas in chronic myelitis there is more or less paralysis.

Prognosis.—Spinal meningitis must always be looked upon as a most dangerous disease; by some authors it has been considered incurable. J. Frank, however, has published a case that was cured by antiphlogistic remedies (*Prax. Med.*, vol. v. p. 76,) and Ollivier has found thickening of the spinal membranes in an epileptic, who died of some other disease. We have seen an instance of acute spinal meningitis under the care of M. Cruveilhier at the Salpêtrière, which completely recovered. These cases, however, are exceedingly rare; and when the malady is fairly established, the prognosis is always most unfavourable, if not fatal.

Treatment.—In the acute form, general and local bleeding is obviously indicated, and should be vigorously employed, so as to produce a marked effect on the pulse, especially if the patient is strong and of a plethoric constitution. Leeches or cupping-glasses should, with or without venesection, be applied over the part which is the principal seat of pain. M. Goss recommends deep incisions on each side of the spinous processes, with a view of opening the veins that communicate with the spinal cord (*Des Maladies Rheumatoides*, p. 231;) we have no proof, however, of the benefits of this severe treatment. Purgative injections, containing a large quantity of fluid, should be given occasionally; purgatives by the mouth, especially such as are of a drastic nature, being contra-indicated, on account of the straining, during their operation, increasing the pain and tetanic spasms. Ollivier advises the cold affusion, or the application of ice to the spinal column, which he says ought to be as beneficial in spinal as in cerebral meningitis; no facts, however, are given in support of this opinion. Warm pediluvia are beneficial, and should be continued some time, care being taken to support the patient in an inclined position, and to prevent, as much as possible, all unnecessary motion. The catheter should be introduced three or four times a-day, to prevent accumulation of urine, and the consequent decomposition this fluid is liable to undergo in the bladder when long retained. Antimonials are hazardous, from their liability to occasion vomiting. If acute pain continue after the employment of the above means, anodynes and hypnotics may be given to relieve it and procure sleep. Absolute rest in the horizontal posture is essentially necessary. A severe antiphlogistic diet must be rigorously perse-

vered in. In the chronic form of the disease, cupping in the neighbourhood of the seat of the pain may be occasionally employed, followed by the counter-irritation, extending over a greater or less surface according to the severity of the symptoms. With this view, moxas, issues, setons, tartar emetic ointment, or the actual cautery, may be employed, so as to keep up a constant irritation and discharge from the part. Blisters are objectionable, as in some cases they occasion strangury and increase the general irritation. From numerous instances we have seen of the effects produced by the actual cautery in diminishing chronic inflammation, we are convinced that it is not only the most efficient, but, on the whole, the least painful mode of applying counter-irritation. The pain, though severe for a time, is not long continued, and on this account, is less in the aggregate than that occasioned by other kinds. In the hands of Professor Syme of Edinburgh, it has frequently succeeded in curing chronic inflammation of the joints, when all other means had failed; and in two cases of chronic spinal meningitis, occasioned by diseased vertebræ, we have seen it produce a complete cure. The triangular cautery of Rust should be applied, at a white, or an intense red heat, for two or three inches on each side of the spine, where the pain is most intense, so as to produce a deep eschar. When the slough separates, water dressing is all that is necessary.

The cold or tepid sea-water douche, or a weak saline solution, poured from a jug or tea-kettle over the spinal column, may be also employed.

Absolute rest in the horizontal posture is also necessary in this form of the disease, and great attention should be paid to the daily change of cushions, and air-pillows, so that the formation of sores on the sacrum and back may be prevented as much as possible.

MYELITIS, OR INFLAMMATION OF THE SPINAL CORD.

Definition.—Symptoms of acute myelitis—of chronic myelitis.—Causes.—Anatomical characters.—Nature.—Diagnosis.—Prognosis.—Treatment.

By this term (from *μελλος medulla spinalis*) is understood inflammation of the spinal cord. The disease has received various names from different authors. It is called *notamyelitis*, by F. Hildenbrandt; *spinitis*, by several French writers; *rachialgitis*, by Brera and J. Frank; *mielitide stenica*, by Bergamaschi, &c: The last two authors, however, have not distinguished this affection from spinal meningitis. The term *myelitis*, first used by Harles (*Dissert. Inaug. Méd. de Myelitide*, Erlangen, 1814,) and subsequently adopted by Khloss (*Dissert. de Myelitide*, Halle, 1820,) Ollivier, Andral, and others, is the best, and the one most commonly used.

Symptoms. The symptoms of *acute* myelitis vary considerably, according to—
1. The period and intensity of the disease; 2. The portions of the cord inflamed; and, 3. The extent to which it may be complicated with spinal meningitis.

1. If the inflammation is not very severe, the first symptoms are numbness and a sensation of cold in the fingers or toes, accompanied with pain and difficulty of moving them. These symptoms gradually affect the upper and lower extremities, and extend to the trunk. Sometimes there is obscure pain in the course of particular nerves; formication; feebleness of the muscles or a kind of subsultus; constipation; retention of urine; affections of the heart; and more or less derangement in the functions of other internal organs, which are often thought to be the primary diseases, while the state of the spinal marrow is overlooked. Under these circumstances, firm pressure or percussion applied to the spinous processes successively, or passing a sponge saturated with hot water along the spine, (as recommended by Mr. Copeland,) will generally detect the seat of the disease. If the inflammation be more active and intense, the disease commences with partial or general convulsions without numbness, while acute pain is felt in the back, extending along the course of the nerves. Sometimes the convulsions are clonic, and in some instances of the tonic character, but there are strong reasons for supposing, that, if there be tetanic rigidity, the meninges are also affected. As the disease advances, and disorganization occurs, there is paralysis, with diminution or complete loss of sensibility. The bowels are generally costive, and the urine is either retained or passed involuntarily; the latter generally occurring during convulsions. Sometimes the paralysis commences in the inferior extremities, and gradually proceeds upwards, until all the respiratory muscles become affected, and the patient dies asphyxiated. Occasionally, but more rarely, the paralysis appears first in the superior, and subsequently in the inferior, extremities; in some cases it is confined to one side of the body only, or to a single extremity. In general, motion and sensibility are lost together, but sometimes the one is paralyzed without the other. Not unfrequently, paralysis appears first on side of the body, and then on the other; or one foot, leg, hand, or arm, may be affected, according to the situation or extent of the disease. The different paralytic phenomena are treated of more at length under PARALYSIS.

2. The general symptoms above detailed are liable to greater or less alteration, according as the inflammation is seated in the cranial, cervical, dorsal, or lumbar portion of the cord.

When the *cranial* portion of the cord is affected, the patient experiences a sense of pricking, and of formication in one or more of the limbs; deep-seated headach; greater or less affection of the special senses, as obscurity or loss of sight, hearing, or smell; sometimes there is delirium; trismus, or convulsions; grinding of the teeth; red and dry tongue; difficulty of swallowing; vomiting; embarrassment, or loss of speech; frequent and convulsive respiration: in some instances, symptoms resembling hydrophobia have been observed, or irregularity in the heart's action and in the pulse; hemiplegia, or other form of paralysis. As the fatal stage advances, the prostration increases; the pulse becomes more feeble; the dyspnoea increased; and the excretions are passed involuntarily.

When the *cervical* portion of the cord is the seat of inflammation, the symptoms are—difficulty of deglutition; impossibility of supporting the head (*Vogel*;) acute pain in the back of the neck; difficult and hurried breathing, the functions of respiration being principally carried on by the contractions of the diaphragm; palpitations; frequent hard pulse; pricking sensations in the fingers or hands; paralysis of the superior or inferior extremities, sometimes of the former only, gradually extending to the muscles of the trunk; and before death, the usual symptoms of failure of the vital powers.

When the superior part of the *dorsal* portion of the cord is the seat of the disease, there is pain in the dorsal region; convulsive movements of the trunk; palsy of the arms and lower extremities; short and laborious perspiration, principally carried on by the external respiratory muscles; palpitation, or tumultuous and irregular actions of the heart, &c.

When the *lumbar* portion, or lower part of the dorsal region is affected, which is the most common seat of the disease, besides a greater or less number of the above symptoms, the loss of motion and sensibility in the inferior extremities is more marked; there are deep and severe pains in the lower part of the back; pain in the abdomen, resembling colic; convulsive contractions of the abdominal parietes; sensation of tightness above the pelvis, as if constricted with a band or cord. Paralysis of the bladder and sphincter ani also is a prominent, as well as one of the earliest symptoms.

3. When myelitis is complicated with spinal meningitis, constituting meningo-myelitis, the symptoms above described are conjoined with those characterizing inflammation of the membranes, such as increased pain on the slightest motion, and more or less tetanic rigidity. The inflammation in these cases is often of greater extent, and the pain is not confined to a circumscribed spot. There are also not unfrequently febrile symptoms, the pulse being quick, strong, and irregular, the skin hot, the tongue foul and dry, and the respiration laborious and frequent. Abercrombie (case 147,) J. Frank, Bergamaschi, and others, have confounded cases of this affection with myelitis or simple inflammation of the cord.

The *duration* of acute myelitis is variable, usually proving fatal from the fifth to the tenth day. Cases are not uncommon where this event has occurred on the third or fourth, and a few are recorded where death has taken place in fifteen or twenty hours. The symptoms are more intense, and the disease more rapidly fatal, when the dorsal portion of the cord is affected, a fact observed by Mr. Earle (*Phil. Trans.*, 1822) and by Ollivier, and attributed with much reason by the former to the small size of the cord in this situation.

The symptoms of *chronic* myelitis are essentially the same as those which characterize the acute; they come on, however, more slowly, and at the commencement are more obscure and difficult of detection. In many cases, long before any pain is complained of in the back, there is a feeling of numbness, pricking, formication, loss of strength, or other obscure symptoms in the fingers, hands, toes, legs, thighs, and other parts of the muscular system. Sometimes there is increased sensibility in these parts. When pain occurs in the back, it is often for a long time considered

to be rheumatism, and is generally mistaken for lumbago or sciatica. The numbness and weakness are generally greater on getting up in the morning, and are often lessened by exercise; the power of motion and muscular strength being also temporarily increased, a circumstance ascribed by Ollivier (vol. ii. p. 427,) to a state of congestion which is favoured by long repose, and in some measure dissipated by increasing the activity of the circulation. The gait of persons affected with chronic myelitis is peculiar, and thus described by Ollivier:—"Each foot is lifted from the ground with difficulty, and in the effort which the individual makes to do this and carry it forward, the trunk is first straightened, and then thrown back, as if to counterbalance the weight of the inferior extremity, which vacillates involuntarily before it is again placed to the ground. Sometimes the point of the foot is drawn downwards, and is more or less dragged on the ground before it is lifted, while, in other instances, it is raised quickly, and at the same time thrown outwards." When there is incomplete paralysis of the fore-arm and hand, objects are obscurely felt, seized with difficulty, and readily fall from the patient's grasp. Complete paralysis is slow in its approach, and is often limited for a long time to one or even to a portion of the extremities, which gradually becomes rigid, and is extended with difficulty and pain. Sometimes there is no rigidity or contraction, but slight pain in the affected limb on motion, or on pressing the hand on the course of the nerves. In the paralyzed parts there is often a perceptible diminution of temperature, and an absence of cutaneous transpiration, rendering the skin dry and scaly. In many cases the heart is much affected, the strength of its contractions being increased and its action tumultuous, while the pulse is weak and irregular. In others there is difficulty of breathing, and the patient is frequently almost suffocated. Ollivier considers that this disease is often the cause of idiopathic asthma. There are occasionally symptoms resembling those of angina pectoris, the paroxysms being in some instances preceded by pain and numbness, extending from the arms to the chest, and in others from the chest to the arms. There is often colic pain, with contractions of the abdomen; cramps in the stomach; painful spasms of the abdominal parietes; sometimes a sensation of constriction, as if a cord was tied tightly round the trunk, with the knot over the spine. There is almost always constipation and retention of urine, which, as the disease advances, is changed into inability to retain the excretions. In the generality of cases, large eschars and sloughs form on the back, under the exhausting discharges from which, the patient sinks. The intelligence is unaffected throughout, unless the brain participates in the disease.

The *duration* of chronic myelitis is generally from one to four years, the immediate cause of death being most generally exhausting discharges from large sores in the sacrum. Some, however, die of gradually increasing debility without these sores; and in others death has been occasioned by a true asphyxia. Individuals have existed under this affection for fifteen or twenty years, with perfect preservation of the intelligence.

Causes. Myelitis (to which males appear to be more liable than females) may be occasioned by falls and blows on the vertebral column; fractures and displacements of the vertebræ; alterations in the bones and ligaments by caries, scrofula, or rachitis. It has been observed by Ribes to follow rheumatism (*Dict. des Sciences Méd.*, art. VERTEBRÆ;) and by J. P. Frank (*De Curandis Hom. Morb. Epitome*, vol. x. p. 50, 51.) and Ollivier, cerebral meningitis, pneumonia, and inflammation of the digestive organs. It may also be caused by sudden changes of temperature, and long exposure to cold and tempestuous weather. Great fatigue and excessive muscular exertion have produced it. MM. Dupuy and Bouley have pointed out its frequent occurrence in the lumbar region of horses subjected to much labour. It has followed also excessive venereal indulgences. Hourtet gives a case where it depended on the venereal disease, and disappeared when the original affection was cured. (*Mém. de l'Acad. Roy. de Chir.*, tom. iv. p. 141.) In a great number of cases, however, myelitis cannot be attributed to any apparent cause.

Anatomical characters. It is rare that death takes place in the early stages of inflammation of the spinal cord; but there is every reason to believe, from the analogy of its structure with that of the brain, that it presents the same appearances as the latter organ. Mr. Stafford describes it when occurring after injuries of the spine as being redder than natural, presenting bloody points when cut into, which, as Dr. Todd has remarked, implies that he has seen the lesion in its early stage. In general, however, the results of inflammation are discovered; such as softening, induration, and suppuration. Softening may exist in any portion of the spinal cord, but it is most common in the lumbar region, and next in the cervical. It presents the same characters that we have described as belonging to softening of the brain, and there are the same doubts in many cases regarding its inflammatory origin. In some instances it occupies only the posterior columns, in others the anterior, but in general, as remarked by Ollivier, the central portions are most affected, though there is obviously much difficulty in establishing whether it is ever confined to the gray matter, as that writer supposes to be not unfrequently the case. Sometimes the whole thickness of the cord is destroyed and reduced to a thickish fluid or pulp, in which no traces of nervous matter can be discovered; in other cases it is only partially destroyed, and fibres of medullary matter can be traced through the softened mass; or with more or less softening, the cord has been found flattened by pressure; for example, by an exostosis. (Janson, *Compte Rendu du Grand Hôtel Dieu de Lyon*, 1822.) Induration is also sometimes met with, most generally in chronic cases, although Bouillaud considers it is a change that often precedes softening. (*Sur l'Encephalite*.) Occasionally, when the cord is indurated, it is also atrophied. Hutin relates a case of chronic myelitis, where the cord was indurated and atrophied, so that it exactly resembled a ligamentous cord. (*Nouvelle Bib. Méd.*, an 1823, tom. i. p. 24.) Sometimes the volume of the cord is increased, as noticed by Bergamaschi, Portal, Laennec, Abercrombie, Ollivier, Andral, Hutin, and others. In some instances the induration is connected with increased vascular action in the part and neighbouring structures, as pointed out by Bergamaschi and Portal; in others it is deprived of all colouring matter, resembling the white of egg, as remarked by Esquirol and the younger Pinel. In a case by Somenkalb, of induration of the cord, it was hypertrophied in the cervical region, the remaining portion being in a state of atrophy. (*Carus Zeitschrift für Natur und Heilkunde*, tom. i. p. 5, 2d year.) Suppuration in the spinal cord is a result of inflammation, which is very rarely met with. Velpeau met with two distinct abscesses, one in the right, the other in the left column; the former three inches long, and two or three lines in diameter; the latter one inch long, and one line in diameter. (*Rév. Méd.* 1826.) In a case published by Mr. Hart, of Dublin, the spinal cord was enlarged in size. On cutting it open, thick purulent matter, which was contained in a cyst, flowed out, occupying the centre of the spinal marrow, extending from the first to the eleventh dorsal vertebra; its diameter was about four lines. (*Dub. Hosp. Rep.*, vol. v.) Dr. Carswell has seen two abscesses in the cord; one on the right side, five inches long and a line in diameter, and another on the left side, an inch long. (Carswell, *Path. Anat.*)

Nature. In the greater number of cases the morbid appearances readily explain the symptoms, according to the general laws of the pathology of nervous diseases formerly alluded to in the preliminary observations, the early inflammation producing irritation, and causing pain, convulsions, and other symptoms of increased action, while the loss of motion and sensibility are in proportion to the amount of pressure on, or destruction of, the different affected portions of the cord. The great majority of the cases also are in perfect accordance with our knowledge of anatomy, and the numerous experiments performed on animals. Some, however, have occurred, in which, when the cervical portion of the cord only has been affected, there has been palsy in the superior extremities above, while the inferior have remained in their natural state, readily obeying the in-

fluence of volition; on the other hand, the lower limbs have been affected while the upper have remained unaffected. These instances are rare, and are only to be explained by supposing that the few fibres not implicated in the organic lesion are capable of performing their usual office of conductors—a supposition perfectly consistent with our knowledge of the special and independent endowment of nervous fibres. Regarding the few cases which have been recorded, in which total destruction of the spinal marrow is said to have occurred, without in any way deranging sensibility or voluntary motion in the lower extremities—a result equally opposed to all our anatomical, physiological, and pathological knowledge, we perfectly agree with the opinion expressed by M. Bouillaud, viz: that it is probable the observers of these cases have committed some error, either in the observation of the symptoms, or in the description of the morbid alterations. (*Dict. de Méd. et de Chir. Prat.*, art. MYELITE.) This point is discussed more fully under PARALYSIS.

Diagnosis. We have already explained how myelitis is to be distinguished from *spinal meningitis* when treating of the last named disease, the leading symptoms in the first being paralysis and loss of sensibility, and in the latter tetanic rigidity and increased sensibility. In the advanced period of the chronic form, the disease of the cord generally becomes complicated with spinal meningitis, and there is perfect paralysis, with rigidity and contraction. Meningo-myelitis is recognised, in the acute stage, by the combination of tetanic rigidity, paralysis, and pain, with more or less fever. The progress of the symptoms distinguishes myelitis from spinal apoplexy, in which latter the effects are sudden. In some cases there is great difficulty in detecting the early stage of the chronic form of the disease from rheumatism, and occasionally it is impossible, unless paralysis is present; but if, on percussing or pressing on the spinous processes, or passing a sponge saturated with hot water down the vertebral column, increased pain is complained of in a particular part of the spine, we may conclude that there is some affection of the cord or its membranes. This method will likewise assist in distinguishing the part of the cord affected.

Prognosis. Acute myelitis generally terminates fatally, probably because the symptoms in the early inflammatory stage are confounded with rheumatism, or other affections, and are treated inefficiently. When disorganization has taken place, we have every reason to believe the disorder to be incurable. The disease is most rapidly fatal when the lesion involves the respiratory nerves. Life is usually prolonged when the lumbar region is affected, although the observations of Calmeil have shown that, even in this case, death may occur quickly. The chronic form may be successfully combated in the early stages. MM. Ollivier and Latour (*Mém. de la Soc. Méd. d'Emul.*, tom. vi. p. 92.) have reported several cases of cure after the disease had existed several months. We have seen one case of well-marked acute meningo-myelitis recover, and another is reported by Dr. Ruse of Baltimore. (*American Medical Recorder*, July, 1825.)

Treatment. The treatment of myelitis, both in its acute and chronic forms, is exactly the same as that recommended for spinal meningitis; and we have nothing to add to what has been there stated. With regard to the value of certain remedies which have been recommended for the cure of paralysis, in the chronic form of the disease, such as strychnine, galvanism, electricity, &c., this subject is discussed in the observations on the treatment of PARALYSIS.

HYDRORACHIS.

Definition.—Congenital hydrorachis.—Hydrorachis developed after birth.—Causes.—Anatomical characters.—Nature.—Diagnosis.—Prognosis.—Treatment.

THIS term (from *ὕδωρ*, *aqua*, and *σπίνα*, *spina*) is applied to abnormal collections of fluid within the spinal column, whether congenital or occurring after birth. Magendie has pointed out, that in the healthy state there is always a certain quantity of fluid in the sub-arachnoid cavity of the spinal canal, which is absorbed soon after death. Whenever, therefore, a considerable quantity of this fluid is discovered twenty-four hours after death, we may consider it morbid, and resulting from previous disease of the brain or spinal marrow. On account of the free communication between the arachnoid and sub-arachnoid cavities of the spinal cord and the brain, it is often difficult to determine whether hydrorachis occurs primarily from the membranes of the one or the other, but if the seat of effusion be between the dura mater and osseous covering, there can be no doubt (as observed by Abercrombie) that it is spinal only.

Congenital hydrorachis in the fœtus or new-born infant is always associated either with hydrocephalus or spina bifida. When connected with the former, all the symptoms of water in the head are present; when hydrorachis is complicated with spina bifida, there are certain local and general symptoms which indicate the affection. These we proceed to enumerate.

On examining the spine, one or more tumors containing fluid are found, situated immediately over the deficiency in the vertebra, most commonly the lumbar, this affection being seldom met with in the dorsal and sacral, and still more rarely in the cervical region. When the disease occurs in the latter situation, there is generally separation also of the cranial bones. There may be one or more distinct tumors in the cervical, dorsal, or lumbar regions, or, if the whole spine is bifid, one tumor may occupy all three regions, being proportionate in length to the number of malformed vertebræ. Feiliz gives a case in which all the spinous processes were deficient, and the tumour occupied the whole length of the spine. (Richter, *Chir. Bibl.*, band 9, p. 185.) In magnitude it varies from the size of a hazel nut to that of an adult head, and is usually of a globular or ovoid shape, but sometimes pyriform, semilunar, or flat, with either a large base or a narrow neck. In a case by Brewerton, it was bi-lobed. (*Edin. Med. and Surg. Journ.*, July, 1820.) To the touch it is either tense or flaccid, according to the position of the infant; for as there is always a free communication between the cavity of the tumor and that of the spine, and generally with the cranium; it is more distended when the infant is in such a position as will allow the fluid to gravitate towards it. By gradual pressure, also, its bulk may be diminished, and if small, all the contents may be thus forced into the spinal or cranial cavity, stupor being often produced from the pressure on the brain. In some cases, as noticed by Cruveilhier, the tumor expands during expiration, and sinks during inspiration, but he was unable to observe movements synchronous with those of the pulse. (*Anat. Descrip.*, tom. iv, p. 564.) The coverings of the tumor may present various appearances, which have been divided by Billard into three varieties. In

the first, the integuments covering the tumor are in a healthy and uninfamed state; in the second, the skin is thin and discoloured, sometimes with exudations of a sero-sanguineous fluid, indicating the approaching rupture of the parietes of tumor; in the third variety, the tumor has burst, the effused fluid escaping through a fine ulcerated perforation, surrounded by a red, rugous, and unequal elevation of the skin. Of these, the first is the most uncommon and the least dangerous. In seven cases observed by Billard, two were born with the skin covering the tumor in the healthy state. Spina bifida sometimes coexists with other malformations, as of the urinary or genital organs; with imperforate anus; malformation in the digestive canal, &c.

The constitutional symptoms of this affection present no remarkable difference from those of other spinal diseases. Infants after birth are generally emaciated and feeble. There is more or less paralysis of the lower extremities, sometimes connected with œdema, occasional convulsions, inability to take the breast, resolution of the sphincters, difficulty of breathing, which, as the disease approaches its fatal termination, becomes stertorous. The infant becomes gradually more and more exhausted, its cries weaker, the extremities cold, the pulse excessively quick and feeble; and convulsions or coma, more frequently the former, precede death. These symptoms bear a relation to the state of the tumour, being less urgent if it is small, and if there be no opening. In the latter case, if the aperture be minute, no distressing symptoms may appear for sometime, though a certain quantity of fluid is continually discharging, or may be pressed out. In this way, several pints have been removed. Very often, however, the nature of the fluid becomes altered, and from being colourless and limpid gets turbid, more or less purulent, and sometimes fœtid. The exhaustion of the little patient is proportionate to the quantity and purulent character of the discharge. These effects are the result of inflammation of the meninges, which sooner or later comes on and destroys the infant. Of the seven cases observed by Billard, he found traces of spinal meningitis in five. If the tumour be large, and burst suddenly, and a large aperture afterwards form, death occurs more quickly, generally preceded by convulsions. This event has taken place in utero without having been immediately fatal. Dugès has given a case where there was a large scar in the sacro-lumbar region, covering a membranous substance, by which the vertebral canal was not very firmly closed. The child perished six weeks after birth.

Hydrorachis developed after birth. Cases have been recorded by Frank and Reydellet, where tumours with an aperture in the spinal canal have occurred after birth. Such cases, however, are very rare, and when the bones of the column are perfectly formed, no tumour is produced except in the sacral region, which is naturally open. Morgagni gives a case from Genga (epist. 12, sect. 9,) of hydrocephalus following a blow on the head, in which a tumour appeared at the coccyx. This was opened, and the head diminished in size as the fluid was evacuated. What farther proved the communication between the fluid in the head and that within the tumour, was, that on pressing the cranium it escaped with impetuosity. Tumours may also be produced by acephalocysts, and the escape of fluid between the vertebral laminæ; cases of which are given by Ollivier.

Hydrorachis developed after birth is generally symptomatic of spinal congestion or meningitis, and may be associated with, or depend upon hydrocephalus. It is characterized by pain in the back, extending a greater or less distance; paralysis of the lower extremities, with numbness or complete loss of sensibility; sometimes œdema of the legs and feet, or gangrene of the toes; paroxysms of convulsions or tremors have been occasionally observed (Bonnet. *Sepulchretum*, tom. i. p. 305, 307;) and resolution of all the limbs, involuntary stools and urine, laborious respiration becoming stertorous before death.

If hydrocephalus, as is generally the case, accompany the spinal disease, all the symptoms of the former affection are combined. Itard gives a case of hydrocephalus, in which, on ice being applied to the head, the cerebral symptoms disappeared, and complete paraplegia followed, apparently from the changed position

of the effused fluid. Dr. Graves speaks of a case in which, when the patient was lying down, the lower extremities could be moved with a certain degree of force, but when the individual stood erect, he could not place one leg before the other. Ollivier attributes this to the presence of serous effusion, which, when the patient was in the latter position, pressed with greater force on the lumbar portion of the cord. When the seat of effusion is between the dura mater, and the bony walls of the vertebral column, as in cases given by Bergamaschi, Ollivier, Abercrombie, and Lallemand, the same general symptoms are present.

Causes. The causes of congenital hydrorachis have been supposed to depend remotely on constitutional disorder in the mother, as syphilis, scrofula, scurvy, or rickets; violent mental emotions, excessive venereal indulgences during pregnancy; concussions or other injuries affecting the mother, and imagined to act upon the fœtus in utero, &c. There is no proof, however, that any of these circumstances bear any relation to the presence of hydrorachis in the fœtus. The immediate causes are organic changes in the placenta or umbilical cord, producing more or less interrupted circulation and subsequent serous effusion into the spinal cord; inflammation of the membranes of the cord, or of the brain, &c. Hoffman imagined that pressure on the head during parturition sometimes squeezed the fluid into the spinal canal. (*Miscel. Nat. Cur.*, obs. 208.) In the majority of cases, however, the occurrence of hydrorachis cannot be traced to any cause. The numerous theories brought forward to explain spina bifida, it is unnecessary to discuss. The causes of hydrorachis, when developed after birth, are of course the same as those which produce the disease with which it is complicated, or on which it depends, as hydrocephalus, spinal meningitis, &c.

Anatomical characters. The characteristic appearance found after death in hydrorachis is the abnormal collection of serous fluid, the presence of which is generally associated with morbid alteration of the neighbouring tissues, such as detailed in the description of spinal meningitis and myelitis. It may, however, be the only morbid appearance present. Dugès gives the case of a man who died with paraplegia, in whom no other morbid lesion could be found except an effusion of serosity in the sacro-lumbar region, that gave the dura mater the appearance of an intestine filled with water. (*Dict. de Méd. et Chir. Prat.*, art. HYDRORACHIS.) The fluid is sometimes limpid, often turbid, flocculent, or mixed with pus. In the latter case it is the result of meningitis or ulceration of the tumour. Its colour may be of a light yellow, green, or black tint, and often more or less sanguineous. The amount of the effusion differs considerably from a slight accumulation of serosity, to such a quantity as fully distends the membranes, occupying the whole of the spinal canal pressing on the brain, or communicating with a fluid in the cavity of the cranium. M. Montault found 14 ounces in the first situation alone. (*Journ. Hebdom.*, August, 1833.) It may exist in three situations:—1. between the pia mater and the arachnoid membrane, the seat of the cephalo-spinal fluid of Magendie; 2. in the arachnoid cavity; and, 3. between the dura mater and bony walls of the vertebral column. When the fluid collects in the first two situations, it generally, but not always, communicates freely with the ventricles, and the arachnoid cavity within the cranium. In two instances Billard observed that the effusion into the cranium, and that into the vertebral canal, was different in colour, showing that they were perfectly distinct, and in one of these the fluid in the fourth ventricle was retained by a firm reddish membrane, which formed a cul-de-sac below its inferior angle, interrupting all communication with the sub-arachnoid cavity. (*Billard*, 3d edit. obs. 69.) Two other cases have been reported by M. Lediberdèr. (*Arch. Gén. de Méd.*, tom. v. 2d series, p. 39.) Cruveilhier has seen a similar membrane to that described by Billard in a case of hydrocephalus, where the fluid was prevented from entering the spinal canal. (*Anat. Pathol.*, liv. xv.) In the third situation it is impossible any communication can exist with the brain, on account of the adhesion of the dura mater to the margin of the foramen

magnum. It must not be forgotten that a serous fluid may be effused into the substance of the cord. In a case given by Portal there was a cavity in the cord extending to the fourth dorsal vertebra, large enough to admit a common quill, distended with serous fluid, and communicating with the ventricles. The serous cysts which are occasionally developed in the cord or membranes, if small, cannot be said to constitute hydrorachis, any more than similar cysts in the brain or its membranes constitute hydrocephalus.

In congenital hydrorachis combined with spina bifida there are deficiencies in the vertebra, which Fleischmann has divided into three classes:—the first comprehends division of the whole vertebra, body as well as processes; the second, imperfect development of the lateral arches only; and the third, development without union of the lateral arches. (*De Vitiis Congenitis, circa Thoracem et Abdomen.* Erlangæ.) The first and third of these are rarely met with. The anatomical character of the tumour also varies, its walls being sometimes natural, composed of skin, dura mater, and one layer of the arachnoid or both, according as the fluid is situated in the arachnoid or sub-arachnoid cavity; in other cases its parietes are more or less diseased, being inflamed, thickened, ulcerated, gangrenous, covered with fungous growths or tufts of hair. In these cases, also, the spinal cord may be more or less affected, its substance being, according to Meckel, either softened, reduced to a pulp, diminished in size, divided into two parts, or expanded into a membrane; according to the observations of Ollivier, however, these alterations are not common. The cord is often preternaturally long, owing, as Ollivier thinks, to the adhesion between it and the water of the lumbar tumour fixing it permanently at a point of the spinal canal where it ought only to have remained temporarily. More rarely the substance of the cord is entirely wanting; the membranes, according to Otto, having fallen together, and being usually slit at one or more places, or they are more or less degenerated, and adherent to each other, forming sometimes a closed sac filled with lymph. Morgagni cites cases from Tulpus, Lechel, and Alpinus, who saw the nerves floating in the aqueous tumour. (*De Sed. et Caus.*, epist. 13.) This has also been seen by Ollivier and Cruveilhier. Mr. Stafford has described the nerves as distributed on the inside of the tumour in which they terminated, and where occasionally they formed a nervous net-work. (*Injuries and Diseases of the Spine*, p. 21, et seq.)

Nature.—The pathology of hydrorachis will always be found in perfect accordance with that of other spinal diseases, and with the facts stated in the general observations. As the palsy which accompanies hydrorachis is explained under PARALYSIS, it is unnecessary to discuss the subject here.

Diagnosis.—In the congenital form, when combined with spina bifida, the situation of the tumor, and the effects of pressure, will readily detect the nature of the disease. When at birth or at a later period it is complicated with hydrocephalus, it is distinguished by the peculiar symptoms of that disease. In these cases, however, in addition to the cerebral symptoms, those denoting lesion of the spinal cord, as convulsions, paralysis of the extremities, rectum, and bladder, are more marked. When it is the result of spinal meningitis, myelitis, or meningo-myelitis, the peculiar symptoms of those maladies are observed. We are not aware of any symptom which may be considered as diagnostic of hydrorachis in an idiopathic form, unless the circumstance noticed by Dr. Graves, formerly alluded to, may be so considered. We have seen two cases of incomplete paraplegia, in which the patients could move the inferior extremities much more readily in bed than when supported in the erect position. As these individuals are still living, it is impossible to say whether this depends upon the gravitation of fluid in the spinal canal; very little attention has hitherto been paid to this point.

Prognosis.—The prognosis in hydrorachis must always be very unfavourable. In the congenital form, when connected with spina bifida, it is not necessarily fatal, many cases having been recorded that existed several years, and in these

death was apparently unconnected with this affection. Individuals have been found in whom this disease was complicated with spina bifida—by Bonn at 10 years; by Martini at 11 years; Paletta and Acrel at 17 years; by Henderson at 18 years; by Copland at 19 years; by Warner, Hochstetter, and S. Cooper at 21 years; by Camper at 28 years; by Cowper at 30 years; and Ollivier cites a case by Swagermann, who saw it in an individual 50 years old. (*Ollivier*, vol. i. p. 227, 3d edit.) Generally speaking, however, the larger the size of the tumor, and the greater the destruction of the cord or brain, the greater is the danger, and this is increased when there is sloughing or gangrene. When the tumor bursts, the patient generally dies quickly in convulsions. Ollivier says, that once only in such a case a cure has followed. The death takes place more rapidly if the laceration in the tumor be large, or inflammation attacks its walls. When other malformations are combined with the disease, it is unnecessary to say the case is more hopeless.

Treatment.—The treatment of congenital hydrorachis with spina bifida may be considered as radical or palliative.

The radical treatment is very hazardous, and in the majority of cases has hastened the fatal result. Sir A. Cooper has cured two cases by repeated small punctures. Probart another (*Lancet*, No. 186,) and Rosette and MM. Robert one each. (*Arch. Gén. de Méd.*, tom. xvii. p. 280, and tom. xviii. p. 102.) In the last two cases the inferior extremities were completely paralyzed, proving that this circumstance does not contra-indicate the performance of the operation. Experience has shown that the sudden bursting of the tumor almost always produces death, by occasioning spinal meningitis; and consequently whenever it presents an inflamed appearance at any point, and is apparently about to break, a puncture should be made with a small cataract knife, at the most depending part of the tumor, and the fluid gently squeezed out. Before the pressure is removed, the orifice should be covered with a piece of adhesive plaster, in order to favour union by the first intention, and a bandage applied so as to occasion gentle pressure, and support the walls of the tumor. After a time this may be repeated if necessary, and the treatment conducted nearly on the principles recommended by Mr. Abernethy for psoas abscess. All other radical methods of cure, such as the ligature, setons, &c., are incompatible and dangerous.

Except under the circumstances we have alluded to, the palliative treatment should always be employed. Compression was proposed by Mr. Abernethy, with a view of supplying the deficiency in the spinal canal, and giving support to the part. Sir A. Cooper applied a plaster of Paris mould to the tumor, to effect this. In whatever manner pressure is applied, care must always be taken that it is gradual, for if it be sudden, or carried too far, convulsions or paralysis will be the consequence. Although this practice is undoubtedly useful, it may be questioned whether the local application be the principal means of cure. Most probably the improvement in the general health, by strengthening the system, increasing the activity of the circulation, and thus preventing local congestion, which tends to keep up or increase the amount of serous effusion, must be the chief indication of treatment in this disease. While, therefore, gentle pressure on the tumor, either by bandages, plaster of Paris, or a discutient plaster, is employed, great pains should be taken to increase the general tone of the system, and apply such remedies as will induce absorption of the fluid, and prevent its tendency to increase. With this view, change of air to a dry situation in the country ought to be recommended, and a healthy wet nurse employed. Small doses of the Hydrarg. c. Cretâ, or one or two grains of calomel, according to the age of the child, should be given every other morning for two or three weeks. The preparations of iodine may also be administered with a view of procuring absorption, or the nurse may undergo a course of this medicine. Small blisters applied above the tumor, in the course of the spine, so as to cause a rubefacient effect only, may be employed frequently. Extreme caution, however, is necessary, that vesication is not produced, as in infants, particularly those of a weak

constitution, sloughing and farther exhaustion may be occasioned. Great attention must be paid to the regularity of the alvine discharges, and gentle aperients given to insure this if necessary. The child should be warmly clothed, and carried out frequently in the open air when the weather is fine.

When hydrorachis is associated with hydrocephalus, or with congestion, or inflammation of the spinal cord or its membranes, the treatment recommended for those affections should be employed. The same measures are to be employed when the disease is developed after birth, the remedies having reference to the age of the patient and the stage of the disease.

There is a form of spinal disease which follows intermittent fever, that seems to be of the nature of that described in the text, as the hydrorachis of adults. I have not had an opportunity of examining cases of this disease, at least not in its early stages, but the sudden appearance of this disorder, the moderate degree of pain, and the comparatively rapid development and extension of the paralysis from the lower to the upper extremities, seem to prove that a liquid must be rapidly secreted in the spinal sheath. The acuteness of the symptoms and their rapid increase, if much motion be allowed, indicate that the disease is of an inflammatory nature. This sub-acute inflammation is a more frequent attendant upon intermittents in some years than in others, but it arises from causes which are totally unknown.

The best means of treating the disease are, rest, frequent cupping to the spine, and repeated blistering: purgatives are also most useful aids, but are less essential than the other remedies which I have just mentioned. These cases, if carefully managed will, in general, terminate favourably, though the disorder is sometimes quite intractable, and may prove rapidly fatal.

G.

SPINAL APOPLEXY.

Symptoms.—Causes.—Anatomical characters.—Nature.—Diagnosis.—Prognosis.—Treatment.

ALTHOUGH there are some doubts as to the propriety of applying the word apoplexy to hæmorrhage into any tissue, its general use has induced us to adopt it to express the spontaneous extravasation of blood into the spinal canal, either between the membranes or into the substance of the cord.

Symptoms. We have noticed, when speaking of cerebral apoplexy, the symptoms denoting hæmorrhage into the cranial portion of the cord. But spontaneous effusion of blood into the cervical, dorsal, or lumbar portions is an occurrence of extreme rarity, and its history is consequently very defective. We have every reason to suppose, however, that hæmorrhage will give rise to the same effects as destruction of these parts by accident or disease, and that they will be more sudden and well-marked, according to the violence and the extent of the effusion. The cases recorded by Abercrombie, Chevalier, Stroud, Cruveilhier, Monod, Grisolle, Gaultier de Chaubry, and others, show that the attack is always characterized by acute and sudden pain in the back, corresponding with the seat of effusion. Sometimes there are precursory symptoms of shivering, and slight dorsal pains, which have been mistaken for rheumatism. In some instances, there is sudden paralysis in one or more of the extremities below the seat of pain; in others, the paralysis comes on gradually, and is preceded by pain in the portion of the spine corresponding with the supposed seat of the hæmorrhage. The other symptoms which have been observed are similar to those we have noticed when treating of myelitis affecting the cervical, dorsal, or lumbar portion of the cord. Eschars are often formed on the sacrum before death; the sphincters are paralyzed, and the respiration becomes gradually more and more laborious; in [the case of M. Grisolle, there was nausea with sense of suffocation, and in that of M. Cruveilhier vomiting of black blood before the fatal termination. In the case of M. Monod, pus and blood has been mingled with the urine, and in that of Abercrombie there was tetanic rigidity and convulsion. In this last case, however, the spinal marrow was not changed in structure, the hæmorrhage having occurred between the dura mater and bones. There is in general no fever, the pulse is not affected, and the intelligence remains perfect to the last.

Causes. Effusion of blood into the spinal canal may result from blows, falls, contusions, fractures, and other kinds of direct violence. Spontaneous apoplexy of the cord has been observed to follow when the individual has remained some time in the sitting posture, from lifting a heavy weight, and as a consequence of rheumatism, cerebral apoplexy, and myelitis.

Anatomical Characters. The hæmorrhage in spinal apoplexy appears to be occasioned by the same causes that produce it in the brain. It may form circumscribed extravasations in the substance of the cord, as in cases recorded by Hutin, Cruveilhier, and Stroud. In such circumstances a cyst forms, and the blood effused undergoes exactly the same changes we have described in cerebral apoplexy. In some instances it is combined with softening (Gaultier and Grisolle,) when the

nervous substance is more or less broken up and mixed with the extravasation. The gray matter appears most liable to this alteration. Hæmorrhage may also occur in the sub-arachnoid or arachnoid cavity, or between the dura mater and bony walls of the canal, as in the case given by Dr. Abercrombie. The effusion may be referred to hæmorrhage occurring in the brain, which is forced into the spinal canal, or to rupture of some blood-vessel in the adjacent structures, to which only, in the latter case, it can be attributed.

Nature. The pathology is perfectly consistent with the known functions of the spinal cord. The amount and seat of the paralysis is attributable to the degree of pressure or disorganization occasioned, and the portion more immediately affected. The study of the recorded cases also shows that the changes after the attack are proportionate to the alterations occurring in the extravasation. The occurrence of convulsions in Dr. Abercrombie's case, in which the effusion was exterior to the dura mater, thus occasioning partial pressure, illustrates well the influence of this cause in producing excited action. This symptom has not been observed, when the extravasation has affected the substance of the cord directly. In Dr. Stroud's case, circumscribed effusion of blood took place on the left side of the cord, producing first hemiplegia of the same side of the body, and afterwards paraplegia. (*Bright's Reports*, vol. ii. p. 339.)

Diagnosis. The diagnosis of this disease is very obscure, as our observation of it is as yet insufficient to enable us to indicate its peculiarities; the premonitory symptoms, however, have been confounded with rheumatism, from which it can only be distinguished by the progress of the case. In general, the sudden and acute pain distinguishes it from other spinal affections, and when the spinal marrow is the seat of the hæmorrhage, there is no convulsion or tetanus.

Prognosis. The case of Cruveilhier, in which the patient lived five years after the first attack, proves that this disease is not always speedily fatal. In the majority of cases, however, the greatest danger is to be apprehended.

Treatment. In the treatment of spinal apoplexy, absolute rest, in order to prevent any recurrence of the extravasation, and to favour the absorption of effused blood, is the chief element. Bleeding should be employed if there be no signs of prostration, but not to any great extent, as the symptoms do not indicate active vascular excitement. The diet should be low, and great attention paid to the alvine evacuations, which are to be regulated by injections, active purgatives being as much as possible avoided. The state of the urinary bladder should be inquired into daily, and, if necessary, the urine drawn off by the catheter. Counter-irritants are obviously useless. Care should be taken to prevent the eschars, which are likely to form on the sacrum and back, by placing the patient on the hydrostatic bed, or by adjusting cushions and air-pillows so as to prevent long-continued pressure on any part.

C H O R E A.

Characteristic symptoms.—Analogous affections.—Anatomical characters.—Nature.—Causes.
—Diagnosis.—Prognosis.—Treatment.

THE disease to which the name of Chorea is most commonly applied, and to which it was first restricted by Chaussieur is characterized by incomplete subserviency of the muscles of voluntary motion to the will, rendering their actions irregular, tremulous, and often ludicrous. It occurs most frequently in the female sex, and in general between the ages of eight and fifteen. The designations, "St. Vitus's dance and dance of St. Guy," became popular in consequence of the practice which formerly prevailed among the subjects of similar affections, to repair annually to a chapel at Ulm, in Swabia, dedicated to the saint, called by the Germans St. Weit, and by the French St. Guy; who, having suffered from the complaint in his lifetime, was supposed to be rewarded with the power of curing it after his death. It is probable that, from the influence of sympathy, a temporary aggravation of the complaint was produced in so large an assemblage of subjects, but it is said that they afterwards remained for a year free from the malady.

In chorea the muscular disorder may either be general, affecting the extremities, trunk, and face, or partial and confined to the face or neck, or to one extremity. It occurs for the most part in persons of a weak constitution, either natural or acquired, and is commonly preceded by derangement of the organic functions, indicated by variable appetite, tumid abdomen, constipated bowels, and impaired vivacity. The convulsive motions are preceded by slight irregular twitchings of the muscles of the face, which may easily be mistaken for voluntary grimaces. In the progress of the complaint the irregular action becomes more intense, and implicates a greater number of muscles; those of the extremities, of the lower jaw, or of the head and trunk, being at different times affected. The patient does not walk steadily, but moves irregularly from side to side, or proceeds by jumps or starts; one foot is rather dragged than lifted, and the movements of the arms resemble the gesticulations of players. As the complaint increases, the patient seems as if palsied, and becomes unable to walk or to perform the necessary movements of the arms. In extreme cases deglutition is difficult, and articulation interrupted, so as to produce stuttering; the mouth is distorted, and saliva drivels from it. Different muscles may be successively convulsed, but those first affected usually continue involved throughout the whole course of the disorder.

In severe cases the irregular actions are never suspended excepting during sleep, and may even continue irrespective of this condition. They may be continuous, intermittent, or remittent; and are increased by observation, contradiction, or any irritating cause, and especially by any attempt forcibly to restrain them. The eye loses its lustre and intelligence. The liability to causeless emotions, and the disposition to concealment characteristic of hysteria, are often present; the mind becomes capricious and irritable, and there is a tendency to take alarm or to weep at the slightest cause. The disease when long protracted may induce fatuity, epilepsy, or hemiplegia, or may terminate in marasmus.

Chorea in the female is frequently associated with deranged uterine function,

sometimes with chlorosis, but perhaps more frequently with amenorrhœa. Hysterical symptoms are in general superadded when the disease occurs about the time of puberty. At this period chorea may be superseded by hysteria, which at a later period may in turn give place to neuralgia, the susceptibility to these diseases seeming to depend on a similar condition of the nervous system, modified by different periods of life. Serous effusions, especially into the arachnoid and pericardium, sometimes attend protracted cases. The complication with rheumatic affections of the muscles, pericardium and spine, has been well elucidated by Dr. Copland, as well as by Drs. Prichard, Roeser and Bright.

Various cutaneous eruptions, of which urticaria and roseola, are the most frequent, may be associated with chorea; but since the irregular movements may either precede, attend or follow the eruption, we must consider the phenomena, not as in the relation of cause and effect, but rather as results of the same state of the nervous centre. It is, however, probable that the eruptive condition tends to moderate the spasmodic disorder.

In the disorder to which we now limit the name of chorea, the will is properly exerted, but is only partially efficient. The analogous affections to which the term has been occasionally applied, consist chiefly in energetic and often measured actions of the muscles, under the influence of a morbidly excited will. Such appears to be the nature of the original chorea of the Germans, of *Tarantism*, and of *Leaping ague*. Sometimes, however, the muscular disturbance seems independent of the will, and unassociated with consciousness, and differs from convulsion only in the orderly nature of the motions. Cases of rotation of the whole or part of the body, of malleation, and of irresistible propulsion forwards or backwards, belong to this class. The phenomena which have occasionally occurred under the excitement of religious enthusiasm, although in the first instance resulting from mental impressions, often become involuntary in their progress.

I. In the first class of analogous affections we may specify the following examples:—

1. The original chorea consisting of inordinate and almost supernatural muscular exertions, depending on a mental impulse and excited by imitation or by music, the measure of which seemed to regulate the movement. Felix Platerus mentions a woman of Basil who danced for a month; and it appears from the accounts of Horstius and others, that the complaint was apt to recur annually, and that those affected would continue dancing when under the influence of music, for an incredibly long period, until at length exhausted by their exertions. (*De Mentis Alien.*, vol. i. p. 15.) Later writers have referred to the affection under the names of *Epilepsia saltatoria* and *Morbus saltatorius*. The first distinctly recorded manifestation of such a malady occurred, A. D. 1027, near Bernberg, on St. John's Day; a festival during which it was customary, perhaps in imitation of Bacchalian rites, to kindle the *nodfyr*, and to dance around or through it with various frantic gestures. There is reason to believe that these performances sometimes gave origin to the disorder in question. For several centuries after this period the affection was occasionally witnessed. The excitement produced by destructive epidemics and other calamities, and the superstitious ceremonies of Popery, probably contributed to its prevalence. In St. John's dance, as well as in that of St. Vitus, and in the affection next to be described, a tympanic state of abdomen was a frequent symptom.

2. *Tarantism* (sometimes designated *Tarantulismus*, *Chorea Sancti Valentini*, *Choreomania*, *Dæmonomania*, *Melancholia saltans*, &c.) in every important particular resembling the affection last described. A few hours after being bitten by the poisonous spider called Tarantula, the patients fell down senseless and motionless, with difficult respiration and heavy sighing. As these symptoms subsided, they appeared desponding and melancholy, frequented church-yards and solitary places, evinced a capricious fancy for particular colours, and sometimes appeared to have an irresistible propensity to roll themselves in the dirt. At the sound of

suitable music they began to move first the fingers, then the hands, feet, and successively other parts of the body, and then sighing and dancing threw themselves into every variety of violent and fantastic gesture. Sauvages says, "Those who are stung die in a little time without the present assistance of music, all other remedies giving no relief." Those affected were capricious as to tune, and required the notes to be run over with the greatest quickness. This quickness of sound, called *terantella*, afforded a test for the detection of those who feigned the disease, a practice, according to Baglivi, common among the women of Apulia, when they wished to be indulged in music and dancing. If they were satisfied with slow musical movements the deception was at once discovered. An instance of convulsive disorder resembling tarantism, produced by the bite of a spider, and cured by music, is related in the *New York Medical Repository*.

3. The *Leaping ague* of the Scotch writers, characterized by increased efficiency, but depraved direction of the will, producing an irresistible propensity to dance, tumble and run about in a fantastic manner, often with far more than the natural vigour, activity and precision. The subjects of the malady, after some pain of the head and lower part of the back, become affected with bodily distortion. They leap in a remarkable manner, climbing or springing from the floors to the rafters of cottages, and swinging by or whirling around them. This state is often accompanied with a disposition to secrete any thing within their reach.

In the *Edinburgh Medical and Surgical Journal* there is an account of a girl affected with this complaint, who also exhibited a remarkable inclination to commence sentences with the last word, and often put the last letter of a word foremost. In writing she would proceed right to left, placing the last word and the last letter first; often with great rapidity, and apparently without consideration. In the treatment of this case, purgatives proved useless; opiates sometimes prevented a paroxysm, but did not permanently relieve. Locked jaw of eight days' duration followed the use of a shower bath, and the symptoms did not return. Some cases of periodical jumping and shrieking, related by Armstrong, following pertussis, and considered epileptic, probably belonged to the same class of affections.

At the close of the seventeenth century, a case in some respects resembling those above described occurred at Edinburgh, and an account of it was published with the title, *A True Narrative of the Sufferings of a Young Girl, who was strangely molested by Evil Spirits and their Instruments*. A commission from the king was appointed to inquire into it, and seven persons were in consequence committed to the flames for witchcraft. (*Edin. Med. Com.* vol. ix.)

II. The second class includes those analogous affections in which the movements are systematic, but involuntary; viz. malleation, rotation, and propulsion in various directions.

1. The affection to which the term *Malleatio* has been applied, examples of which have been described by Morgagni, Dr. Crawford, and other writers, consists in an apparently irresistible disposition to beat the knees with the hands as with a hammer. The action is regular but involuntary, and occurs in paroxysms.

2. Instances have occasionally occurred of involuntary rotatory motion of the whole or part of the body. For example, rotation of the head has been observed by Drs. Conolly and Crawford, and Mr. Hunter has related a case in which rotation of the head and trunk occurred, and was relieved by the application of tartar emetic ointment to the scalp and spine. Under the name of chorea, Dr. Watt has related the case of a girl ten years of age, who, after suffering from vomiting and excruciating headach, evinced a singular propensity to turn round on her feet like a spinning-top. On the subsidence of the affection (in about a month) the head was aggravated, and the muscles of the neck were partially paralyzed. After this, paroxysms occurred daily, in which she placed herself across the bed, and rolled rapidly on her side, from one end to the other. About sixty

rotations were accomplished in a minute. They were not checked by the affusion of cold water; indeed, when placed in the shallow bed of a river, the girl kept up the motion, although at the risk of being drowned. In about five weeks a different movement was substituted, namely, that of approximating the head and heels, raising the trunk, and then falling forcibly on the back. These motions continued to characterize the affection for five weeks, when they were succeeded by a propensity to stand on the head, to raise the feet perpendicularly, and then fall as if dead; these evolutions were performed more than twelve times a minute for fifteen hours daily. The malady did not yield to blisters, setons, local depletion, emetics and cathartics, which were successively employed, but disappeared after a spontaneous diarrhœa.

3. Propulsion, either forwards, backwards, or in zigzags, has occasionally occurred. M. Piedagnel has given an instance of a man who sometimes went out and walked forwards till he was exhausted and obliged to be carried home in a litter (*Magendie's Physiology*, by Milligan, p. 189;) and Dr. Laurent of Versailles, has related a counter part to this case, in a girl irresistibly propelled backwards with such violence, as to sustain considerable injury. Drs. Dufour and Rennis (*Arch. Gén.; Lond. Med. and Surg. Journ.*, June, 1832) have related examples of zigzag movements occurring in persons addicted to intoxication, who had previously suffered from bronchitis. The phenomena were at first mistaken for those of drunkenness, but yielded to the use of opium.

Mr. Kinder Wood has recorded a most interesting example, in which the phenomena of the original chorea were associated with malleation, rotation, propulsion, and leaping ægue. It occurred in a woman whose nervous susceptibility was probably increased by prolonging lactation for fourteen months, the catamenia having appeared during the latter three months. At first she suffered from pains of the face, which were relieved by a liniment of opium and ammonia; twinkling of the eye, motions of the legs, and rotation of the arms, succeeded. The palms of the hands were beat upon the thighs, and the feet upon the ground, the backs of the wrists were struck frequently against each other; at other times the middle fingers being extended inwards, struck the palm of the opposite hand, and so alternately with almost inconceivable quickness. The affection of the eyelids was usually succeeded by headach of short duration, with sickness and vomiting. On some occasions she would move up and down, or from side to side on her chair, and then springing on her feet, leap and jump, or be propelled forwards. Sometimes she would go into every corner of the room, striking the furniture. She would frequently dance on one leg, holding the other in the hand. In the course of the complaint it was observed, that the blows on the furniture were in musical time, and the involuntary actions, as they were considered, changed to a measured step. Although ordinarily an inexpert dancer, she would on these occasions move about elegantly in a minuet. It was ascertained that there was always a tune in her mind, impelling her to the movements. When this tune was performed on the drum, she ran up to the instrument and danced with great activity and apparent delight, but the movements were always stopped by rolling the drum. Although yielding, as it seemed, unavoidably to the desire of dancing, she always wished for the rolling of the drum, that the muscular excitement might be checked; for, till a new impression was made by a change of measure, the morbid desire prevailed over the rational will. As occurs in tarantism, the motions always commenced in the fingers and then extended to other parts of the body, and became more frequent as their duration lessened. On the day the motion ceased, diffused patches of a bright red eruption came out near the elbows, and continued for three days. The catamenia afterwards appeared, and health seemed established. In five weeks, however, the muscular movements recurred, and the eruption appeared on the arms. This attack lasted about ten days. Five weeks afterwards the affection returned for the third time, but assumed a more spasmodic character; when laid down the patient turned involuntarily on her back, and the muscles of the neck were so affected as to force back the head

and occasion dyspnoea. On this occasion no relief was obtained from music, but a cure was effected by bleeding. The previous attacks had been treated with aperients, tonics, and anodynes; and it is worthy of notice, that in each instance the most decided improvement succeeded the use of calomel and jalap. The catamenial function was suspended at the time of the malady, but had been previously regular.

III. The convulsive disorder which has sometimes occurred in religious assemblies, and has occasionally prevailed as an epidemic, is usually accompanied with shouting, singing, dancing, laughing, and coughing, with irregular exacerbations and remissions. During a remission, shaking hands with, or even looking at a person affected with the complaint, will excite a paroxysm. The seizure is at first violent and convulsive, and continues even on lying down, but after a time becomes chronic, and more closely resembles chorea.

The phenomena have been well described by Dr. Robertson, as they occurred among a sect of enthusiasts in Tennessee and Kentucky, in the year 1800. (*Inaug. Essay on Chorea St. Viti*, 1805.) A similar affection occurred in a congregation at Cambuslang, in the year 1742. The movements, which were at first voluntary, became spasmodic, the muscles of the neck and upper extremities were convulsed, and the sufferers were thrown down and agitated with motions like those of a live fish upon land.

Anatomical characters. The opinions of authors regarding the morbid anatomy of chorea are extremely various, and the descriptions of occasional appearances serve chiefly to prove that there is not necessarily any structural change. Dr. Clutterbuck considers the disease dependent on inflammation of the brain; Drs. Coxe and Patterson on turgescence of its vessels with tendency to hydrocephalus. Roeser and Willan have found serum in the ventricles. Monod refers the malady to hypertrophy and injection of the brain and spinal cord; Hutin to hypertrophy and hardening of the anterior part of the spinal cord. Changes in the membranes of this part, such as the effusion of turbid serum or lymph, or the formation of bony plates, have been described as occasional phenomena by Drs. Copland, Prichard, Aliprandi, and Bright; and ecchymosis of the membranes, with a pulpy state of the medulla spinalis, was detected in a case related by Dr. Keir of Moscow. (*Edin. Med. and Surg. Journ.*, No. cxxii, p. 93.)

Dr. Serres having found, in one case, a tumour pressing on the corpora quadrigemina, in two instances inflammation of these parts, and in another example sanguineous effusion, is disposed to refer the disease to a morbid condition of these organs. Dr. Brown discovered a concretion in the medullary substance of the left hemisphere of the brain. In Dr. Hawkins's case there was increased vascularity of the uterus, with concretions in the pancreas, omentum, and mesentery. Dugès, Ollivier, Rufz, Gerhard,* Hache, Rostan, Lawrence, and many other pathologists have, however, searched in vain for any morbid changes which could be regarded as necessarily connected with the disease; and it is evident that many of the appearances above described must be considered simple coincidences; whilst others, as Drs. Patterson and Percival have observed in reference to hydrocephalus, must be viewed rather as effects than causes of the complaint. Since the scalpel fails to reveal the seat of the malady, we must have recourse to the light which physiological investigations may throw on the inquiry. There is considerable evidence in favour of the opinion, that the stimulus of the will passes from the

* The case cited by the author was that of a young girl of nine or ten years of age, who died purely of the disease, that is, worn out by the excessive and continued movement. No lesion whatever could be detected in the brain or spinal marrow, although I examined those organs with the most scrupulous attention. It is cited in the memoir of Dr. Rufz. (*Archives Generales.*)

brain through the spinal cord to the voluntary muscles; and the conclusion which Magendie has deduced from his experiments, namely, that the will passes through the hemispheres of the cerebrum, and that the direct cause of motion is in the medulla spinalis, is at least plausible. The disturbance of harmony between the part which supplies and that which conveys the stimulus of the will to the muscles, must be sufficient to produce the irregular movements of chorea; and this harmony may probably be interrupted by derangement, whether structural or functional, of any part intervening between the cerebral hemispheres and the portion of the spinal cord from which the nerves of the affected muscles proceed. The frequency with which, in extreme cases, change of structure of the cerebro-spinal axis has been observed, is favourable to this view, since long-continued functional derangement, although it does not necessarily occasion organic change, will frequently produce that result.

There is direct experiment in support of this explanation of the cases of propulsion forwards and backwards, and of rotation, which have been above described as in some respects analogous to chorea. Magendie found, that when the corpora striata were removed, the animals operated on darted irresistibly forward; and that, when injury was inflicted on the cerebellum or medulla oblongata, they receded. (*Op. cit.*, p. 187, 202.) The experiments of Serres, Flourens, and Rolando, are favourable to the same conclusion. When the peduncles of the cerebellum were divided, rotation took place towards the side cut; and vertical sections of the cerebellum, or pons varolii, produced the same effect, which was always most decided in proportion as the injury was near to the peduncle, the movement being to the right or left, according as the incision was right or left of the mesial line. Lesions of the medulla oblongata, where it approaches the external part of the anterior pyramid, occasioned a rotatory movement; but, on cutting through the spinal cord behind the occipital bone, the motions became involuntary and irregular. In connexion with these inquiries it may be interesting to mention, that effusion, into the ventricles, pressing upon the corpora striata, has been constantly found in horses affected with inability to go back.

The physiology of the nervous system is not sufficiently advanced to enable us to fix the locality of its individual functions; allowing their full weight to the experiments and observations which have been referred to, we are not authorized, with Serres, to limit the seat of chorea to the corpora quadrigemina or striata, or with Bouillaud and Magendie to the cerebellum.

Cases of rotation may probably depend on derangement affecting the pons varolii, medulla oblongata, or the peduncles of the cerebellum; propulsion forwards on an altered state of the corpora striata, and backwards on morbid condition of the cerebellum: but the correct exercise, yet inefficient power, of will, which characterizes true chorea, seems rather to indicate an affection either of the spinal cord, or of some part closely approximating to it. Tarantism and the chorea of the Germans may probably consist with integrity of functions of these parts. The muscles in those affections accurately obey the stimulus of the will which exists in excess, possibly from excitement of some part of the sensorium, more directly connected with the mind, perhaps individual faculties of the mind, inasmuch as they are associated with material structure, may possess a power of stimulating to action analogous to will; and which, in contradistinction to the rational will, may be termed instinctive.

The morbid excitement of this power rendering it uncontrollable by the judgment, may occasion some of the irresistible actions present in affections analogous to chorea, and may also produce some of the phenomena of monomania, to which, indeed, these maladies seem closely allied.

Nature. Galen and Mead considered the disease a modification of palsy; Sydenham regarded it as a convulsive disorder, occasioned by a humour affecting the nerves; Baumes and Pinel attributed it to a combination of convulsion and palsy; Sauvages, Cullen, and many others, have referred it to a state of general debility, and consequent mobility of the system: others, among whom

Drs. Parr and Hamilton may be particularly mentioned, consider that the derangement of the muscular actions arises from sympathy with disorder of the digestive functions.

Chorea may doubtless occasionally arise from a morbid condition of the cerebro-spinal axis or its membranes, sometimes induced by the excitement of mental impressions or moral emotions; but the peculiar irritation of the nervous system essential to the malady, seems to be generally associated with, and probably dependent upon, disorder of the organic functions, which, acting on a susceptible nervous system by means of the ganglionic nerves, may sympathetically interrupt the functions of those parts which convey to the muscles the stimulus of the will.

Causes. When derangement of the bowels occur in young subjects of susceptible nervous system, almost any powerful impression, either on the mind or the body, may be sufficient to excite the disease. Among mental causes, jealousy, envy, anger, disappointment, anxiety, and excited imagination, may be mentioned, but fright is generally allowed to be the most frequent. A majority of the cases related by Dr. Reeves, Mr. Bedingfield, Dr. Bright, and others, are referrible to this cause; and its influence in producing chorea cannot be denied, notwithstanding the contrary opinion of Guersent, who argues that the liability to be easily alarmed is a characteristic of the morbid condition, rather than the cause, of the malady. The disease is occasionally induced by the irritation accompanying the second dentition. Mechanical injuries (*Med. Chir. Rev.* vol. ii. p. 569,) especially of the head (*Edin. Med. and Surg. Journ.*, vol. ix. p. 123; and *Med. and Phys. Journ.*, vol. xv. p. 127,) and through the orbit (*Phil. Trans.*, vol. liii,) suppressed eruptions, the healing of ulcers, extension of rheumatism to the spinal membranes, worms and intestinal accumulations, and the influence of fever or other previous disease, are among the causes enumerated by authors of repute. Dr. Marshall has detailed a case resembling chorea, apparently produced by lightning. The symptoms were much aggravated by pressure at certain points of the spine. The example is of peculiar interest in connexion with the evidence adduced in Dr. Marshall's work, of the occasional production of softening of the spinal cord by lightning. It also serves to illustrate some milder examples of the disease, which were relieved by treatment applied to the spine.

All the causes of constitutional debility, whether hereditary or acquired, are favourable to the production of chorea; but premature excitement, either of the intellectual faculties or moral feelings, sedentary employments, innutritious diet, and impure air, may be especially mentioned. Females are much more liable to the affection than males. The proportion in Dr. Reeve's cases was 57 to 27; in Dr. Manson's, 53 to 19; in those of M. Ruzf, 138 to 51: from these statements, and from the recorded experience of Heberden, Frank, Elliotson, and Copland, the liability of the sexes may be calculated as in the proportion of 3 to 1. The time of life in which the disease is most common is from the period of second dentition to puberty; but instances have occurred as early as the fifth year, and the disease has been known to exist from infancy. No age, however, seems to be absolutely exempt, Dr. Copland having witnessed the disorder in a man above fifty years of age, Dr. Powell, in a woman, *ætat.* seventy, after epilepsy, and M. Bouteille associated with hemiplegia in a woman, *ætat.* eighty. The complaint appears to be little influenced by atmospheric changes; but Ruzf, Dugès, Blache, and Spangenburg, consider it most common in summer. There is reason to believe that it is very rare in the southern hemisphere, M. Rochoux not having witnessed any example in Guadaloupe, Chervin in the Antilles, nor Danste in the course of thirty years' practice in Martinique. Imitation has little influence in the production of the disorder. In the Hôpital des Enfants, Blache never witnessed its production by this cause.

Diagnosis. The characteristic partial dependence of the irregular muscular motions on the will, is sufficient to distinguish chorea from most other disorders.

In convulsions, whether epileptic or hysterical, the movements are more violent, and are entirely independent of the will. In paralysis agitans, a disease for the most part of later life, the agitation is more constant, more limited, and is devoid of ludicrous character. The tremor produced by mercury has a greater resemblance to chorea, but is accompanied with a peculiar quick catching. In cases combining the phenomena of chorea and hysteria, attention to the history and attendant circumstances will enable us to analyze the symptoms as far as is essential for practical purposes.

The *prognosis* is generally favourable, chorea being scarcely ever fatal, and becoming dangerous only when associated with, or merging in, any more formidable disease, such as epilepsy, dropsical effusion into the serous cavities, paralysis, or change of structure of the brain or spinal cord. Dr. Elliotson observes, that when the disorder is confined to the muscles of one arm or of the head, and especially when occurring in the adult, he has never seen it cured. Since the susceptibility of the nervous system is less in the adult than in the child, the probability of the existence of important organic lesion is greater when the disease occurs in advanced life, especially if the limited nature of the malady implies a local seat.

Treatment. Cases which are not very severe, frequently yield to almost any plan which, without impairing the strength, produces a decided effect on the system. Hence it is easy to explain the diversity of remedies recommended by different practitioners; Dr. Bardsley senior, mentions, that in the Manchester Infirmary, notwithstanding the variety of treatment adopted by successive practitioners, an incurable case had not presented itself in the course of thirty-three years. Still the duration of the complaint, and the facility with which it is remedied, will often in a great degree depend on the judicious adaptation of treatment. A case, for example, may be cured in two or three weeks by suitable treatment, which, under less appropriate management, would be protracted for several months.

The general abstraction of blood has been adopted by those who considered the disease congestive or inflammatory, and has been sanctioned chiefly by M. Bouteille, Lisfranc, and Dr. Clutterbuck, who repeats the bleeding at intervals of a few days. Serres, considering the disease to depend on congestion or some other morbid state of the corpora quadrigemina, applied leeches and counter-irritation to the upper part of the spine. Dr. Watt speaks favourably of bleeding, but Cullen and Armstrong found it frequently injurious.

The purgative plan has been adopted chiefly by Whytt, Hamilton, Cheyne, Guersent, and Chapman, and by a large proportion of the most successful practitioners. Dr. Hamilton generally cured the disease by these means alone in ten days or a fortnight. The purgatives which have been most employed are aloes, senna, calomel, scammony, and jalap, but probably sufficient discrimination has not always been exercised in the selection of the individual remedy.

Of the vegetable tonics employed in the treatment of this complaint may be mentioned cinchona bark, as particularly recommended by Cullen, Mahon, and Werlhoff; the flowers of the cardamine pratensis by Sir George Baker and Michaelis; the powder infusion or decoction of Seville orange-tree leaves by Haen and Engelhard.

Among the metallic tonics may be enumerated, the oxide of zinc, which was considered a specific by Mr. Bedingfield, and is favourably noticed by Dr. Crawford: many of the German authors commend its powers, but Stoll has not observed any advantage from its use. The sulphate of zinc is much employed by Dr. Bright, and is preferred to the oxide by Dr. Copland. The latter author confirms the statement of Dr. Odier of Geneva, that the addition of two grains of ammoniuret of copper to each dose of the oxide of zinc, prevents that remedy from irritating the stomach. The nitrate of silver, which was recommended by Frank, Uwins, and Crampton. Fowler's arsenical solution, in doses of three minims, gradually increased to ten, three times a-day, has been advantageously

employed by Mr. Martin and Dr. Gregory. But the use of arsenic is sometimes productive of injurious effects, an objection which applies also to sulphate of copper and nitrate of silver. Of all tonics iron is perhaps the safest and most efficacious. Dr. Elliotson's experience leads him to confide in the remedy without the previous use of purgatives. He prefers the sesqui-oxide in doses of from half a drachm to half an ounce, but sometimes administers from one to four grains of the sulphate.

Cold-plunging was the method constantly employed by Dupuytren; his plan was to immerse the patient suddenly five times in twenty minutes: this treatment continued for a fortnight, or at most a month, generally cured. Dr. Hamilton was accustomed to adopt this measure previous to his employment of the purgative plan; but attributes bad consequences to its use. It is difficult to suppose that a disease, associated with so much organic derangement, could be removed by the shock of the cold bath without the risk of superinducing some other malady. The use of cold affusion or the shower bath, the patient standing in warm water, is not liable to the same objection.

Extract of belladonna in doses of a sixth to a quarter of a grain was administered by Stoll, who at the same time employed an antispasmodic liniment with great advantage. Valerian is recommended by Bouteille and Guersent, assafoetida by Bayle and Jadelot, musk by Bardsley, and a combination of camphor and extract of henbane by Dr. Bright.

Among internal counter-irritants may be specified spirits of turpentine, first prescribed in this disease by Dr. Copland, a solution of tartar emetic by Ferran, large doses of the same remedy (from four to eight grains) by Breschet, and emetics by Laennec. External counter-irritants, such as blisters, setons, and issues, have been employed by many practitioners, and by others tartar emetic ointments, or plasters to the scalp and spine; and Chrestien advises aromatic embrocations.

Galvanism, recommended by Mcyreaux, and electricity, first introduced as a remedy by De Haen, appear to act as counter-irritants. The application of electricity often produces an eruption of the nature of lichen urticatus. This agent seems especially efficacious in cases associated with defective catamenial secretion, and has been lately employed by Dr. Addison with considerable success.

The above enumeration is not intended to imply, that the authors referred to confided exclusively in the remedies which they particularly sanctioned, since many of them were accustomed to combine and vary resources according to the peculiarities of individual cases.

If the opinion be correct, that the disease usually depends on nervous mobility, associated with derangement of the digestive organs, whether we regard these conditions in the relation of cause and effect, or as simultaneous expressions of the same diseased state, it is equally obvious that two indications are presented, viz. the correction of the morbid state of the digestive organs, and the removal of the nervous susceptibility. The relative degrees of these two conditions doubtless vary. Probably the nervous affectibility is less in Scotland than in England; and from this circumstance we may derive an explanation of the fact, that Dr. Hamilton found purgatives adequate for the cure of the cases which fell under his management, whilst the same mode of treatment has often failed in England. Dr. James Johnson tried purgatives alone without success in cases which afterwards yielded to the administration of oxide of zinc with alteratives and antispasmodics.

Of twenty cases treated by Dr. Bardsley on the purgative plan only fourteen were cured, and the average duration of the treatment was more than six weeks. Of twenty cases treated by purgatives for a time, and afterwards by antispasmodics, the whole were cured in an average period of less than a month. Dr. Bardsley tried the uncombined antispasmodic treatment, selecting remedies of acknowledged power, such as camphor, opium, valerian, ether, and musk. He gave a fair trial to the tonic method, employing the sulphate and the carbonate of iron, the ammoniurets of copper and of iron, oxide of zinc, nitrate of silver, and

arsenical solution. He also had recourse to iodine, strychnia, electricity, the shower bath, tartar emetic ointment and blisters to the spine; and he derived from his experiments the conclusion, that no single plan of treatment was entitled to confidence, and that the combination of purgatives and antispasmodics was the best.

The principle of combination was also countenanced by Sydenham. His method was to employ purgatives, tonics, and antispasmodics; and although he perhaps carried depletion to too great an extent, in other respects it is probable that his treatment has not been much improved by subsequent practitioners. We are strongly impressed with the desirableness of commencing the treatment with purgatives. Underwood has indeed objected to the opinions of Parr and Hamilton, that if the intestinal irritation which they assume exist, it is dangerous to increase it by the employment of purgatives; but whatever may be said of the theoretical explanation, the advantage of commencing the treatment of chorea with purgatives may be considered established.

Dr. Bright, who seems to disparage the purgative plan, employs chiefly calomel, scammony, and senna, and Dr. Bardsley aloetics; but Dr. Hamilton rarely omitted occasional doses of calomel with jalap; and we believe that when this combination is not contra-indicated, it is the most efficacious in the treatment of chorea, freely emulging the biliary ducts without producing much irritation. The advantage derived appears to be proportioned not to the quantity of scybalæ passed, or to the amount of irritation induced, but rather to the production of free secretion without concomitant irritation.

The indications in the management of chorea are, 1. To ascertain the existence of any congestion or irritation of the cerebro-spinal axis, and if such a condition be found to exist, to relieve it by moderate local depletion; 2. To act freely on the bowels by suitable purgatives; and 3. To administer remedies calculated to invigorate the frame, and thus to diminish nervous susceptibility, and increase the energy of the digestive function.

1. In some cases of chorea, although by no means a large proportion, various symptoms, such as pain and heat of head, throbbing of the carotid or temporal arteries, suffusion of the eyes, tenderness at the back of the neck or other parts of the spinal column, and excitement of mind, indicate congestion or inflammation of the cerebro-spinal axis or its membranes. In such instances the abstraction of blood cannot safely be dispensed with, and should be succeeded by counter-irritation, and the application of cooling lotions to the head and of warmth to the extremities. The state of the pulse will materially assist us in determining the extent to which the abstraction of blood may be carried. Unless the pulse possesses some degree of incompressibility, the application even of a few leeches will often be productive of eventual injury; and it is better to deplete less than the urgency of the symptoms may appear to indicate, trusting to the use of purgatives, which, if not alone sufficient, prove most important auxiliaries in correcting the condition above described. All excitement of the senses must be as much as possible avoided, light and noise being excluded; the mental faculties must be suffered to rest, and moral emotions be restrained.

2. In the simple form of the disease, the judicious employment of purgatives is sufficient materially to moderate the symptoms; we are accustomed to confide chiefly in occasional doses of calomel and jalap, followed in a few hours by castor oil, and repeated at intervals of two or three days. Spirit of turpentine will sometimes prove a valuable auxiliary, especially when there is reason to suspect the presence of worms in the intestinal canal. The number of doses of calomel and jalap must be regulated partly by the appearance of the intestinal evacuations, partly by the effect produced on the muscular disorder, and on the general health. While the evacuations continue scybalous and fetid, the repetition of the calomel is usually indicated; but when the secretions become natural, the occasional employment of milder aperients, such as castor oil, or a combination of the infusions of gentian and senna, may be substituted. Sometimes the irregular

muscular actions disappear in less than a fortnight, under the use of purgatives; at other times the symptoms are temporarily relieved, but after a few days recur or increase. Under such circumstances we have immediate recourse to the tonic plan, which indeed may often be commenced after the first or second dose of purgatives.

3. In cases characterized by general debility, tonics may be required almost from the commencement of the treatment; and few cases occur in this country, in which they are not eventually required to render the cure rapid and permanent. The diversity of opinions regarding the most effectual tonic has been already noticed. Dr. Bright prefers sulphate of zinc, especially in cases produced by fright, in doses of from one to ten grains; in patients of weak and irritable habit, nitrate of silver combined with aloes and myrrh may be suitable: but we have rarely met with instances of which the indications were not readily fulfilled either by the sesquioxide of iron or the sulphate of quinine; each of which medicines has occasionally succeeded after the failure of the other. In cases characterized by general laxity of fibre, or by decided intermissions, quinine has appeared to be most effectual.

In the majority of instances, however, especially in those accompanied with deficient energy of circulation, or in which undue repletion has been employed, iron has far surpassed all other tonics. Dr. Elliotson finds that it may be continued notwithstanding the presence of headach and paralysis, and there seems to be scarcely any limit to the quantity which may be administered. Mr. Maclure has detailed the case of a little girl who took more than thirty pounds in a few months with advantage.

In many instances ten or fifteen grains in treacle or sirup of orange-peel, given three times a-day, will accomplish the object; sometimes it is necessary to increase the dose to several drachms. Valerian and calumba may occasionally be given with advantage combined with iron and an aromatic. By some practitioners antispasmodics have been considered essential, and they must not be despised as auxiliaries; but we consider them rather as palliatives than remedies, and repose more confidence in the permanency of cures accomplished chiefly by the agency of purgatives and tonics. Dr. Bardsley recommends musk and camphor, in doses of four grains each every four hours, and every evening an enema containing twenty or thirty drops of laudanum in four ounces of assafoetida mixture. The tendency of laudanum to produce constipation and cerebral congestion is an objection to its frequent use, and the object may probably be as effectually obtained by a combination of camphor and extract of henbane. The sulphur bath is very generally used at Paris in these complaints: Baudelocque has found it almost invariably efficacious. The power of the remedy in improving the condition of the capillary circulation, regulating the bowels, and augmenting the general vigour, render it well deserving of greater attention than it has yet received from the Profession in England.

Treatment of complicated states. Chorea in the female is so frequently associated with amenorrhœa, that it has been referred by Bouteille to a puberty difficult to establish. In such instances a combination of Pil. Galbani Co. with Pil. Aloes et Myrrhæ forms a suitable medicine. If proofs of congestion be present, leeches may be applied to the upper part of the thighs or to the back; if there be deficient tone, or a state of anæmia, the Tinct. Ferri Muriatis, or some other preparation of iron is indicated. In cases accompanied with chlorosis, a combination of iodine with iron is singularly efficacious. A draught containing from five to ten grains of carbonate of iron, and from five to ten drops of tincture of iodine, may be given twice or thrice a-day; or if the bowels be too irritable to bear internal stimulants, the transmission of electrical shocks through the pelvis will sometimes accomplish the object.

Complications with disease of the heart and pericardium, or of the spinal cord and its membranes, require careful treatment: if of an inflammatory nature, well-regulated depletion and counter-irritation must be employed; if there be rheumatism, without inflammation, ammoniated tincture of guaiacum, with ser-

pentaria and camphor, will be appropriate. Cod liver oil may be given to patients who can tolerate the remedy.

In cases combined with paralysis, or with stuttering, especially when occurring in adults, and exciting suspicions of effusion under the arachnoid, the use of iodine has sometimes produced gratifying results. The iodide of potassium when pure, in doses of from three to five grains judiciously administered, is a safe and powerful remedy. In some cases a course of mercury may be required.

It is obvious that in the treatment of the disorder, as well as in the management of convalescence, the general habits of mind and body, and the regulation of diet, demand especial care.

The shower bath, and subsequently sea bathing, are useful tonics, especially when followed by friction of the skin. Mineral waters adapted to the peculiarities of the individual case may be employed with advantage—Pyrmont, Spa, Tonbridge, and other chalybeates, being well adapted to the pallid and leucophlegmatic; Ems to cases characterized chiefly by irritation; and Carlsbad perhaps more especially to instances of the disease associated with the strumous habit. Free exercise in country air is very desirable, and the use of the skipping rope, horse exercise, or other sports accustoming the muscles to prompt and accurate subserviency to the will, should not be neglected.*

* The use of warm sulphur baths, made by dissolving the sulphuret of potassa, was introduced by Dr. Baudelocque at the children's hospital of Paris, and the practice was found to be very successful. No other remedy was used. In private practice, these baths are inconvenient, but they will sometimes be useful as an adjuvant to other modes of treatment.

G.

H Y S T E R I A.

General observations.—Division into three forms—regular—irregular—complicated.—Diagnosis.—Prognosis.—Causes.—Nature.—Curative treatment.—Moral management and preventive treatment.

THE term Hysteria, although established by long usage, seems to have been generally employed with more than ordinary vagueness too often characteristic of attempts to designate disease. It is also liable to the objection of suggesting a theory of the complaint, which is extremely questionable; yet as attempts to substitute other titles have not been more successful, we might readily submit to the etymological inaccuracy of the appellation, if it answered the useful purpose of conveying to the minds of medical men the idea of a certain and definite series of phenomena. Unfortunately, however, the idea attached to the name by various practitioners is almost as varied as the phenomena themselves; and the word Hysteria owes perhaps much of its popularity to the convenience with which it may be employed to cover our ignorance, and to furnish a receptacle for those cases which, in the present state of our knowledge, cannot easily be referred to any distinct place in the nosological arrangement. It must be allowed that the progress of pathology has not materially tended to curtail these cases, but it is on that account the more important to endeavour to fix their limit, and to assist the student in their recognition. The peculiarities of individual constitution occasion varieties in the phenomena of most complaints, which render it extremely difficult to frame definitions accurately representing their essential characteristics. It cannot, therefore, be deemed surprising that a disease, pre-eminent in the irregularity and variety of its symptoms, should defy all attempts at rigid definition, although a description of its principal phenomena may be given sufficiently specific for practical purposes.

The phenomena of the hysterical paroxysm are well known; but those who are prone to such attacks are often subject to other affections, naturally referred to the same predisposition.

A similar condition not unfrequently exists in some who rarely or never present the more prominent phenomena; and we therefore find it necessary to treat of the disease, not merely as an assemblage of certain characteristic symptoms, but also as a general condition disposing to the production of various analogous disorders, when suitable exciting causes are presented. We may, therefore, describe hysteria as a peculiar nervous susceptibility, leading to the production of symptoms remarkable for the capriciousness of their character, the changeableness of their seat, and the suddenness of their accession and subsidence, the function of nutrition being seldom interfered with, notwithstanding their severity and long continuance. The mental condition of hysterical females is generally modified, and often distinguished by sensitive feelings, sudden impulses, and fickle temper. Sufficiently well-marked cases of the disorder have occurred in men, under the influence of sexual restraint or of depressing passions; but it more especially appertains to women, whose originally susceptible nervous system has been rendered

more than naturally mobile by an injudicious system of education: and it is from the age of puberty to the cessation of the catamenial function that the greatest liability to the malady is observable.

The difficulty of conveying an idea of the varied phenomena of hysteria will perhaps be diminished by describing the disease under three forms: the *regular*, the *irregular*, and the *complicated*. This division will best enable us to exhibit the characteristic features of the malady, although when we come to the subject of treatment, it will be necessary to modify the arrangement.

1. *Regular Hysteria.* The *regular* form may be distinguished by its strikingly paroxysmal character. The patient does not necessarily present any symptoms of habitual disorder, but is liable, under the influence of slight exciting causes, physical or mental, and sometimes without any appreciable cause, to sudden attacks of a spasmodic nature. After feelings of general uneasiness, and perhaps headach, cramp, or stiffness about the throat, and a vacant stare, or irregular movement of the eyeball, a sensation as of a ball is felt in the left iliac region, which, rising upward to the throat, produces the feeling called *globus hystericus*, sometimes followed by a violent fit of laughter, alternating with weeping, and in milder cases the patient quickly returns to her usual state. In more severe seizures there is great mental and bodily agitation, oppression of chest, dyspnœa, palpitation, and incapability of utterance. The sufferer falls down, and beats her breast or the pit of her stomach, in which situation there is often violent pain. The breathing is slow and laborious; the abdomen extremely distended and flatulent. Sometimes the patient strikes her head, tears her hair, and attempts to bite her arms, or even the person who may be near her. The limbs are either motionless or convulsed; and the body is perhaps supported on the heels and back of the head. The violence of the contortions may occasionally intermit, and be again renewed, but after considerable eructation, vehement expiration, and perhaps sobbing or laughing, the patient comes to herself, often retaining, but not generally acknowledging, a recollection of much that has passed during the paroxysm, but complaining of fatigue, and sometimes suffering from temporary paralysis of the bladder, arms, or other muscles either of voluntary or involuntary motion. Frequently there is a copious excretion of limpid urine. In some instances the fit lasts for several hours, and, instead of the usual favourable termination, passes into a state of coma, or of syncope, rather peculiar in its character, and sometimes so closely resembling death as to have led to serious mistakes.

Those who are liable to attacks of regular hysteria, usually possess a susceptibility, which renders them prone to hurried breathing, or to sighing, sobbing, or laughing, under the influence of ordinary emotion, and they are, for the most part, apt to pursue objects with ardour, and to exaggerate grievances. The more severe paroxysms chiefly occur when the catamenia are suspended, the bowels torpid, or the digestion deranged. Those who have been long subject to these attacks frequently have tenderness at the sides of some of the vertebræ, which, however, is seldom suspected by the patient, and only discovered by a close examination.

When the complaint has continued for many years unchecked, the nervous system becomes more seriously affected, and paraplegia, weakened memory, or even mania, may ensue.

2. *Irregular Hysteria.* The irregular form of hysteria may exist without the occurrence of decided paroxysms. The phenomena which it presents are indescribably various. There is scarcely any part the function of which it may not disturb, so as to excite the suspicion of organic disease: but the rapidity with which the morbid condition is transferred from one part of the system to another, and the marked disproportion between the symptoms, are generally sufficient to indicate the real nature of the malady, although there is probably no class of cases in which errors of diagnosis are so frequent.

The most constant symptom is pain under the left mamma, confined to a small

space, and not necessarily increased by a deep inspiration. Sleep is generally disturbed; there is great susceptibility to impressions, whether bodily or mental, and generally a liability to palpitation, spasmodic cough, flatulent colic, tenderness of skin, or to neuralgia of a peculiar character. A few of the more marked phenomena require particular notice. Hysterical *headach* is sometimes fixed to one spot, particularly of the forehead, over one eye, producing the sensation as of a nail driven into the part; hence called *clavus hystericus*; at other times it may affect the whole head, and be attended with tenderness of the scalp, intolerance of light or sound, and other symptoms of phrenitis. This state is often associated with an irritable condition of the uterus; it is not removed by the remedies of indigestion, but is generally relieved by nervine medicines.

The subjects of irregular hysteria generally evince much capriciousness, inconstancy, and irritability, and are sometimes liable to temporary *delirium*, presenting a very peculiar character, intermediate between somnambulism and mania. One patient will hide her head under the bed-clothes and shun observation; another will employ outrageous language, and endeavour to injure those who approach her, to destroy children, or to commit suicide: a third will sing, or repeat words in some language with which she is not ordinarily familiar, but of which, under this particular state, she seems to possess a vivid recollection.

The hysterical condition sometimes produces *dysphagia*. It is not necessarily spasmodic, but may depend on defective action of the voluntary muscles. The difficulty of swallowing is sometimes so great as to excite suspicions of hydrophobia. The opposite condition of remarkable avidity for swallowing has been observed. In the *Dublin Medical Journal*, vol. iii. an interesting example is related by Dr. Graves, in which any attempt to interrupt the process of swallowing was followed by hysterical convulsions. The œsophagus is sometimes so remarkably sensitive, that the introduction of a probang is sufficient to produce a decided hysterical paroxysm. (*Bright's Medical Reports*, vol. ii. p. 257.) Sydenham observes that hysterical patients often spit a thin saliva for many weeks, as if produced by Mercury: the same phenomenon has been noticed by Mauriceau, Stoll, Rowley, and Darwin. Dr. Graves thinks it is secreted from the fauces. In some hysterical subjects we have observed the tongue covered with a profuse thick secretion resembling cretaceous mixture.

The laryngeal muscles may be either in a state of irritation, or of deficient power. The former state not unfrequently occurs in young hysterical females, producing in some instances spasmodic closure of the glottis; in others fits of loud convulsive cough, often followed by stridulous inspiration and threatened suffocation. The attack generally comes on in the evening; it may last two or three hours, and close with a common hysterical fit, or with syncope or convulsions, but is never fatal. The intervals of healthy respiration, the absence of fever, of pain on swallowing, or of tenderness on pressure, distinguish this affection, when simple, from chronic laryngitis; but in some instances the two disorders exist together.

Hysterical cough may be hard, loud, and solitary, producing hurried breathing, palpitation, and perspiration, and is sometimes followed by a long sonorous expiration, not unlike the howling of a dog. At other times the paroxysm consists of short, rapid, tearing coughings, producing great distress and exhaustion. Mental emotion is a frequent cause of these affections; and it is worthy of notice that, of three cases of this character mentioned by Dr. William Stokes, one on dissection exhibited proofs of meningitis; and the phenomena of the other two furnished strong grounds for suspecting a similar condition. (*Treatise on the Diseases of the Chest*, p. 266.)

Loss of voice may occur at the catamenial period from mental emotion, or from slight intestinal irritation. It comes on and ceases very suddenly, often without evident cause. Any great excitement sometimes restores the power of articulation for a time, but on its cessation the voice is again reduced to a whisper.

Hiccough is occasionally among the phenomena of irregular hysteria, or an exclamation resembling the latter half of hiccough, which we have known to continue without intermission for many days and nights.

Palpitation of the heart, characterized by extreme violence, and by the slight nature of the causes which induce it, is no uncommon occurrence. Bellows' sound, in the region of the aorta, is sometimes produced in such patients by mental emotion; but its irregularity and want of persistency soon betray its nervous origin.

The stomach is, in some instances, peculiarly irritable, rejecting a large portion of every thing taken into it. The vomiting is not much influenced by the nature of the diet, and is often accomplished with very little effort. It generally occurs soon after taking food, but may sometimes be controlled by a powerful effort of the will, and it is remarkable how long it may continue, without materially impairing nutrition.

Spasm of the abdominal muscles producing a hard and knotted surface is occasionally observed.

Tympanitic distention of the abdomen may proceed to such a degree, as to cause the patient, if immersed, to float on water; and, through neglect of the simple expedient of percussion, has been mistaken for ascites. This state probably depends sometimes on partial paralysis of the intestinal muscles; sometimes on secretion of gas. The gas thus produced, in a case of hysteria, was analyzed by Dr. Osborne, and found to consist of carbonic acid gas with a slight proportion of nitrogen, hydrogen, and carburetted hydrogen.

Hysterical ischuria is more frequent than is generally supposed, being often overlooked by the practitioner, or concealed by the patient. It sometimes depends on deficient secretion, at other times on defective action of the will. In the former case the affection is not relieved by the catheter, and in the latter is rendered more obstinate by its use.

There is a form of neuralgia which may justly be considered hysterical. It comes on suddenly, is generally attended with puffiness and tenderness of the skin, and often with alternate heat and chilliness of the part affected, and is peculiarly apt to migrate from one place to another. The pain under the left breast, which may almost be considered pathognomonic, more particularly of irregular hysteria, is probably of a neuralgic character.

The joints enjoy no immunity from the all-pervading influence of the disorder, but are liable to be affected with morbid sensibility or severe pain. The hip and knee joints are the most frequent seats of the complaint; and in the latter the inner side, and apparently the branches, of the anterior tibial nerve. Serious local disease is too often suspected, and sound limbs have sometimes been sacrificed to this mistake. With a view to diagnosis, it may be observed, that pinching the skin gives as much pain as pressure on the joint; that examination gives less pain, if attention is directed to other objects; and that there is no wasting of the limb, or painful starting in sleep. To enforce the importance of such discrimination, it will be sufficient to quote the remarkable statement of Sir Benjamin Brodie—"I do not hesitate to declare, that among the higher classes of society at least four-fifths of the female patients who are commonly supposed to labour under diseases of the joints, labour under hysteria and nothing else."

The voluntary muscles may be affected in different degrees of violence or extent. One or more muscles is sometimes attacked with paralysis, as complete while it lasts, as that which arises from softening or compression of the spinal cord. At other times there is periodical or permanent contraction of the limbs; or a condition which has been denominated "leaping ague," characterized by a remarkable propensity to skip, swing, dance, and jump, in a degree to which the powers of the patient, in the natural state, would be unequal.

Various perverted sensations, such as inordinate hunger and thirst, might here be noticed, but the catalogue of symptoms is already sufficiently voluminous. We have known the majority of those above described to occur successively in the same individual, but a very few, if well defined, will be sufficient to authorize our

referring them to that remarkable disorder which has defied "all systems of nosology, all doctrines of pathology, and all kinds of remedy except time."

3. *Complicated Hysteria.* When the other diseases attack persons of hysterical constitution, the symptoms of the two complaints may be so blended, that the more important malady may be modified or even masked. Such a complication may increase the formidable aspect of the principal disease, without necessarily augmenting the danger, although it may eventually augment existing disorder by promoting inflammatory action at the extremities of irritated nerves.

Common continued fever is often ushered in by hysterical phenomena, which may also indeed occur during its course, especially in the form of croupy breathing, spasmodic action of the abdominal and respiratory muscles, fits of laughing and crying, &c. During convalescence from fever, such phenomena may appear in males as well as in females, and are probably in part dependent on debility. When hysterical complications attend the latter period of phthisis, or of other chronic diseases, the pain of head, throbbing of the carotids, and excitement of the imagination, by which they are often characterized, may induce an apprehension of phrenitis; but free depletion rather aggravates than relieves the symptoms. To attempt a description of all the various complications of hysteria would, however, be a vain and useless task.

Diagnosis. There are few disorders which hysteria does not occasionally simulate; but the variety, changeableness, and incongruity of the symptoms; the irregularity of their course, and the rapid alternations of violent derangement, and of a nearly natural state with which they are attended, generally disclose to the observant practitioner the true nature of the malady. When accompanied with spasmodic phenomena the disease may be mistaken for epilepsy, and in its chronic form for hypochondriasis.

The genuine epileptic paroxysm is generally sudden, making its onset with a shrill cry; the eyeballs are distorted; the pupils dilated; the teeth ground against one another, or closed upon the tongue, which is protruded from the mouth; the face is swollen, discoloured, or ghastly, and the larynx spasmodically closed, occasioning ineffectual efforts at expiration. The fit is followed by heavy sleep, and on waking the patient does not recollect what has happened. The countenance of those who have suffered long from the complaint, becomes dull and inexpressive. The hysterical paroxysm seldom occurs in the streets, and is characterized by laughing, crying, and the sensation of globus; the muscles of the face and the pupils of the eyes remain nearly in their natural state; the respiration is heaving and sighing. After the fit the patient has more or less recollection of what has passed; and although disposed for quiet, seldom falls into profound sleep. There is in general no evidence of organic disease, and the habitual physiognomy is restless or lively. A combination of the two conditions may, however, occur. In *epileptic hysteria* the patient laughs on one side, and the eyeballs are distorted. In hysterical epilepsy the fits are more frequent than in pure epilepsy, and are more apt to be produced by mental emotion.

Hypochondriasis and hysteria have been regarded as identical by various authors, particularly by Lepois, Highmore, Sylvius, Sydenham, Boerhaave, Van Swieten, and Whytt; but the more ancient opinion of their diversity, supported by Hippocrates, Celsus, Galen, and Aretæus, has been in later times sufficiently established by numerous writers, among whom Willis, Hoffmann, Sauvages, Cullen, Pujol, Loyer-Villermay, Georget, and Brachet, hold a conspicuous place. The last mentioned author regards hysteria as a spasmodic affection of the cerebral, nerves, and hypochondriasis as a morbid condition of the ganglionic nerves, but it is very questionable, whether the present state of physiological knowledge authorizes such theoretical refinement. It may be sufficient to mention, that hypochondriasis is characterized by a false direction of the moral energy, and is generally associated with inactivity, a concentration of interest upon self, and a disposition to have recourse to a great variety of medical practitioners. Hysteria is accompanied with vicious innervation, fitful activity, and often with a lively interest

in the welfare of others, and with confidence in the usual medical attendant. The former disorder is marked by sullen countenance, gloomy ideas, and dejected spirits; the latter by a restless animated expression, convulsive paroxysms, and fickle temper. We must, however, remember, that the two diseases are not incompatible, and that *hysterical* hypochondriacism does occasionally occur.

The circumstances which may assist in distinguishing various isolated affections incidental to irregular hysteria from organic diseases of the same parts have been already noticed; it must be here noticed, that the coma of hysteria may be distinguished from apoplexy by the variableness of the pulse, and the occasional intervention of symptoms inconsistent with compression of the brain. The tenderness of abdomen present in some hysterical cases may be distinguished from peritonitis by its superficial character, and by the absence of the sinking or yielding physiognomy which serious disease of that part usually produces. The concurrence of regular pulse with violent pain, or of irregular pulse with slight symptoms, and the presence of other and well known hysterical phenomena, rarely fail to elucidate the real nature of the disorder, however alarming it may at first sight appear. Laycock mentions the plumpness of the form, large mammæ, and dark areolæ, as characteristic of the hysterical diathesis, and when these circumstances are present they certainly merit attention.

Causes. Dubois has advanced the opinion, that hysteria is an exaggeration of the sanguineo-nervous temperament. (*Hist. Philos. de l'Hypochondrie et de l'Hysterie.*) Persons possessing that constitution are doubtless particularly prone to the disease; but a certain mobility or affectibility of the nervous system seems also necessary. Parents who are gouty, epileptic, or in any way sickly, are most apt to engender this condition in their offspring; but the conduct of early life may also remarkably conduce to its development. The various emotions resulting from social life, rendered more frequent and intense by civilization, and the exercise of the sensations rather than of the active powers incidental to the same state, appear to increase the general susceptibility of the nervous system. From the influence of luxury, indolence, and sentimental reading, the hysterical habit is becoming a common characteristic of the female inhabitants of towns, and gaining increased prevalence among our country population. In like manner females who have been long inured to an active hardy life, when removed to the mansions of the opulent, often acquire the hysterical susceptibility. The causes of plethora sometimes induce a liability to hysteria in nervous habits, and particularly to the convulsive form of the complaint; but the disposition is more frequently produced by the causes of debility, such as a sedentary life, attacks of fever, excessive evacuations, or the long-continued use of sedative, depletory, or irritating remedies.

Nature. The question regarding the intimate nature of hysteria is one of peculiar difficulty, rather increased than diminished by a reference to its literary history. Hippocrates adopting the opinion of Pythagoras and Plato that the uterus was an animal, referred the phenomena of hysteria to the wanderings of this animal to the head, throat, liver, and limbs. Arctæus embraced the same absurd doctrine. Galen refuted the notion of the movements of the organ, but agreed in making it the seat of the disease, and Ætius illustrated the view of Galen. The theory of Hippocrates was afterwards revived by Holler and Duret, to be again confuted by Baillou, who substituted, for the movements of the uterus, a chilling malignant humour arising from the same source.

The principal views which have since been entertained by authors may be arranged as follows:—1. Hysteria has been referred to a morbid condition of the uterine nerves by Cullen, Pinel, Lieutaud, Louyer-Villermay, and Foville, &c., and to chronic inflammation of the uterus by Pujol. 2. A morbid condition of the stomach with imperfect digestion, producing, according to Cheyne and Parry, acid humours, and, in the opinion of Piteairne, imperfectly concocted blood, affecting the brain through the arteries, and to gastro-enteric inflammation by Broussais. 3. Congestion of the lungs and heart by Highmore, and of the vena

portæ by Stahl. 4. A morbid condition of the nervous system generally by Dumoulin, Loob, Pomme, Lorry, Whytt, Tissot, Boerhæave, Hoffmann, Sauvages, Andral, and numerous other writers. 5. A morbid condition of the brain or cerebral nerves by Lepois, Willis, Barbeyrac, Georget, and Brachet. A morbid condition of the spinal cord by several recent authors, and of the ganglionic system by Van Swieten, Lobstein, and Willis. Amard ascribes hysteria to disorder of the lower portion of the spinal cord. Frank, M. Colson, Drs. Bradley, Brown, Darwall, Griffin, and Marshall, refer it to a more or less general irritation of the same organ; and Tate, to spinal irritation connected with irregular or defective catamenia.

The information afforded by morbid anatomy respecting hysteria being almost entirely of a negative character, affords us but little assistance in the attempt to determine its essential nature. Villermay has quoted cases from Diemberbroeck, Vesalius, and Morgagni, to prove the frequent coexistence of disease of the ovaries. Georget has endeavoured to connect the phenomena with changes in the brain, and Broussais with morbid appearances in the intestinal canal; but no sufficient evidence has yet been adduced to prove the dependence of hysteria on any structural change, and we are therefore left to form our opinion chiefly from analogy.

Extensive disordered action may be considered as a change of vital properties; and since life is not monopolized by any one of the organs or structures, but diffused through them all, we must avoid the error of hastily limiting disease to single organs, which may perhaps be affected only as parts of the whole. At the same time the evidence adduced by Geoffroy St. Hilaire and Serres, to show that the development of the body has a remarkable reference to the nervous system, and the instances continually presenting themselves in which various functional disturbances are produced by causes acting directly on the nervous centre, authorize the suspicion that a disorder, characterized by peculiar nervous susceptibility, depends on a morbid condition of this particular system; and although physiology does not at present enable us to fix precisely the functions of individual parts of the nervous system, yet a remarkable analogy may be traced between the effects produced by indisputable changes in the cerebro-spinal axis and the phenomena of the disease under review. We believe with Dr. Marshall Hall, that the spinal cord is "the axis of a system of excito-motory nerves, which is the peculiar seat of action of certain diseases, and of certain causes and remedies of disease;" and although the nature of such actions may be inappreciable, there are various considerations which give force to the opinion that they constitute the essential source of hysterical disorder.

Injuries and diseases of the spinal cord often produce effects resembling the phenomena of hysteria. Krimer found the urine become limpid when the cord was divided in the dorsal or lumbar region; Chausset observed loss of voice produced in dogs by division of the cord in the neck; and Nassé noticed the same result from its division in cats and rabbits.

Inflammation or disorganization of the cervical portion of the cord often produces vomiting, impaired deglutition, sensitiveness of the œsophagus, or interrupted respiration; and a similar condition of the cervical or dorsal region may occasion convulsions or palsy of the muscles of the trunk; and it is a natural conclusion that phenomena similar in kind, though less permanent and less severe, may result from functional disturbance of the same parts. This opinion derives strong confirmation from the case recorded by Dr. Billing, of a man aged twenty-eight, who having strained his spine by falling with a heavy load, suffered afterwards from globus hystericus and palpitation. (*Lancet*. vol. iv. p. 426.)

Various hysterical symptoms are often associated with puffiness of the integuments, and a peculiar sensitiveness of the cutaneous nerves of some part of the spine, and may often be increased by pressure at the sides of the vertebræ. We have observed this condition in connexion with painful affections of various parts, difficult deglutition, cough, eructation, colic, and fainting. Such symptoms are frequently relieved by local treatment directed to particular parts of the spine.

It is true that some phenomena illustrative of hysteria may be produced by irritation of the sympathetic ganglia: for example, contraction of the intestines from irritation of the splanchnic ganglia or celiac plexus, as proved by Volkmann and others; but this fact is not inconsistent with the explanation proposed, since there is reason to believe that the brain and spinal cord are the chief sources of power to the organic nerves, and the reflex action of the sympathetic is most readily excited by irritation of the cerebro-spinal.

It is highly probable that interference with that part of the nervous axis more directly connected with the eighth pair is the condition most essential to the production of the characteristic phenomena of hysteria, the parts supplied by this pair being so remarkably influenced by the disorder, and its lesion, from whatever cause, being productive of analogous changes of function. Brachet found the sensation of hunger, which is apt to be morbidly felt in hysteria, suspended by the division of the par vagum; and Gendrin has related an interesting case of cough of a decidedly hysterical character produced by exposure of this nerve to the atmosphere, in consequence of opening a neighbouring abscess, which subsided as soon as a cicatrix perfectly closed the wound. In order to appreciate the important relations of this nerve, we must remember its communication with the corpora restiformia, the corpora olivaria, and with those fibres of the corpora pyramidalia, which pass into the cerebellum: we may thus trace its influence on sensation and respiration; and if the views of Gall and Spurzheim be true, we may even derive an explanation of its relation to sexual conditions through the cerebellum. If the opinions of Bellingeri be correct, we can readily understand how increased, perverted, or impaired sensations or motions of various parts may be produced, according as different portions of the gray or white matter are most affected; and we may refer interference with the state of the rectum or bladder to a similar disturbance of the lateral strands of the medulla spinalis. The close connexion of the different parts of the cerebro-spinal axis, and the ready transference of congestion or irritation from one part to another, will readily explain the mutability of hysterical symptoms; and we thus reduce to a simple and connected arrangement the "disorderly heap of phenomena," of which the disease has been defined to consist.

Dr. Conolly is of opinion that causes productive of irritation in various viscera may occasion the nervous disturbance producing hysteria; but Dr. Copland thinks it essential, that the nervous or vascular condition of the sexual organs should first be affected. It seems difficult, however, to reconcile the doctrine, that the uterine system is necessarily concerned in the production of hysteria, with the fact, that the disorder may coexist with every appreciable variety in the condition of this system, with menorrhagia or amenorrhœa, with inflammation in various degrees, or without any disturbance at all. The existence of a *special irritation* seems scarcely consistent with such a variety; and when the function of an organ is unaltered, there is no ground for supposing it disordered.

The occurrence of all the characteristic phenomena in men is fatal to the uterine hypothesis. Napoleon in his boyhood is said to have had a fit of hysteria from wounded pride. Dr. Ferrear (*Medical Histories and Reflections*) relates the case of a young man affected with globus hystericus and apparent insensibility, yet retaining consciousness, and who was treated successfully with an emetic, antispasmodics, and afterwards tonics. In the *Edin. Med. and Surg. Journ.*, vol. xi., there is an account of a strong, healthy man who had alternate laughing and crying, and inability to speak, from a feeling of something in the throat. If additional evidence be required of the occasional occurrence of hysteria in men, we might refer to the statements of Lepois, Willis, Whytt, Sydenham, Hoffman, Trotter, Cullen, Watson, Georget, Conolly, Billing, and even of Villermay; and although some of the cases described by these writers may seem referrible to sexual conditions, there are many which are not capable of such an explanation. Several have fallen under the observation of the author in children of each sex, and in adults under circumstances of debility or mental depression, which cannot

be referred to such causes; and it cannot be denied that treatment applied to other parts will often effect a cure without changing the condition of the sexual organs. At the same time it is readily allowed that, owing to its great nervous endowment, the uterus must be fully as competent as other organs to produce sympathetic disturbance of the nervous centre; and it is equally natural to conclude, that an organ possessing such intimate associations with that centre must be peculiarly liable to be affected by its derangements: and hence it will often be a problem in such cases, whether the uterus is primarily or secondarily concerned.

In his very instructive work on local nervous affections, Sir Benjamin Brodie has attributed the susceptibility to their occurrence to imperfect development of the nervous system; but since of all parts of the body the nervous system is perhaps that which least frequently exhibits marks of insufficient development; since it often contributes by its derangements to the disorganization of other parts, and yet survives the ruins it has caused; and since in maladies of a nervous character its actions are rather perverted than enfeebled, and more frequently exalted than deficient, whilst the susceptibility to them is greatest in youth, and diminished by the progress of age, this opinion, notwithstanding the deserved eminence of its author, seems to be questionable.

When the condition of the nervous system above described exists, a very slight excitement will be sufficient to induce hysterical symptoms. Among these, emotions of mind of whatever kind, as of grief, joy, unrequited affection, jealousy, disappointment, or surprise, are conspicuous. The force of imitation is also very remarkable. Dr. Mead supported the popular opinion, that the fits were peculiarly liable to occur about the time of new and full moon. Fanciful as such an opinion may be, we are not perhaps authorized entirely to repudiate statements regarding lunar influence on the animal frame. The opinion that electrical agency may affect nervous subjects is gaining ground, and has the decided support of Rostan. The principal exciting cause, however, is irritation in some important organ; and since the association of hysteria with such conditions is the most important circumstance in reference to treatment, it will be found desirable to adopt a corresponding division of the malady as the basis of a more simple and available arrangement of practical remarks.

Treatment. During a paroxysm of hysteria it is important to adopt such measures as may be necessary to prevent the patient from sustaining injury during the violence of the struggles. Any tight clothing about the neck or waist should be loosened. Cold water may be sprinkled on the face, and stimulating scents applied to the nostrils. If the patient can swallow, a dose of ether, fœtid spirit of ammonia, or tincture of valerian, may be administered, or an enema of assa-fœtida, turpentine, or of iced water, which is recommended by Professor Chiappa as peculiarly effectual in arresting the fit. Some modifications of treatment are required even during the paroxysm, by peculiarities of the individual case; and in the intervals they are more especially requisite according to the varieties of aspect which this Protean malady assumes; but it is hoped that an arrangement may be introduced, by means of which the principles of treatment may be simply expounded and readily applied. If the view which has now been offered be correct, namely, that the essence of hysteria consists in a peculiar disorder of some portion of the nervous centre which may produce the symptoms, either spontaneously under ordinary influences, or by irritation communicated from other organs, we obtain a division of the disorder into the *idiopathic* and the *sympathetic*. It is probable that the brain cannot produce the symptoms except through the medium of the spinal cord, yet, as these parts are so closely connected, we shall combine them in our view of the idiopathic form of hysteria, and consider it a cerebro-spinal disease.

Sympathetic hysteria may probably be produced by disorder of any organ, since even a wound of the finger may occasion it; but as its principal sources are the intestines and the uterus, we shall embody our remarks on the treatment of the disorder under the divisions of intestinal and uterine.

Idiopathic Hysteria. In this form there is no evidence of disorder of any organ except the cerebro-spinal axis, but the conditions of this part may vary in different cases, so as to require a corresponding modification of treatment. The principal diversity regards the state of the circulation; and it is therefore convenient to subdivide this form into, 1. the congestive, either with general plethora or local determination of blood, and 2. the atonic.

1. The congestive variety of idiopathic hysteria often depends on a state of general plethora. This condition is apt to occur in those who are well nourished, and lead a sedentary life. It generally assumes the form which, in the preceding arrangement, has been described as regular hysteria, and is characterized by violent paroxysms occurring most commonly just before the return of the catamenial period. The convulsions are often severe, the face flushed, the arteries of the neck and head throbbing, the conjunctival vessels distended. In some cases fatal coma has followed these attacks. This, therefore, is the form of hysteria in which depletion is generally safe, and sometimes necessary. During the paroxysm, bleeding or cupping between the shoulders will be desirable. Cold should be applied to the head, and if stimulants be administered, the ammoniated tincture of valerian should be given rather than brandy. The purgative plan must be subsequently adopted. A dose of calomel with jalap or colocyinth should be promptly administered, followed by a more or less continued use of saline purgatives combined with senna. The occasional repetition of the calomel may be requisite. Late hours, hot rooms, and feather-beds must be avoided, the diet must be light and unstimulating, and exercise on foot must be enforced. As in this form of the disease the paroxysms are generally ushered in with headach, cupping on the first occurrence of that symptom will often avert the attack; but it will be important, by an assiduous attention to diet and medicine, to obviate the necessity of a very large abstraction of blood. Other cases are associated with local congestion rather general plethora, and require much care in their investigation and treatment. When the brain is chiefly affected, there may be headach and flushing of the face. One part of the head may be hotter than another: there may be occasional delirium, or some peculiar form of temporary monomania, as a disposition to destroy children or to commit suicide. The sudden occurrence of the symptoms, their temporary and variable character, their dependence in many instances on moral excitement, and their association with other hysterical phenomena, will enable the practitioner to distinguish them from cases of chronic derangement. The patient sometimes lies unconscious of all around her, with torpor of the senses, or even with dilated pupils: but in addition to other modes of distinguishing this from the hydrocephalic or apoplectic states, it may be mentioned that the countenance retains more intellectual expression than in those disorders. In these instances leeching, or cupping *moderately employed*, are often advantageous, or if the strength seems unequal to the abstraction of blood, dry cupping will sometimes answer the purpose. Five or six glasses applied to the nape of the neck, and retained there for ten or fifteen minutes, will often avert the hysterical fit, if employed as soon as headach or other symptoms indicate its approach. Turpentine is a useful remedy. A drachm suspended in mucilage, with the addition of a few drops of tincture of capsicum, may be administered three times a-day, or several drachms combined with castor oil may be introduced as an enema. Great attention must be paid to the regulation of the bowels and to the promotion of a free catamenial secretion.

When local congestion about the spinal cord exists, there will in most instances be found puffiness and tenderness of the part affected. The tenderness probably depends on a sympathetic condition of the cutaneous nerves, for the spinal cord is too well protected to be directly influenced by external pressure.

A large proportion of cases of irregular hysteria are associated with this condition, particularly those characterized by spasmodic closure of the glottis, spasmodic cough, dysphagia, palpitation, hiccough, and vomiting. These phenomena are faithfully described and instructively illustrated in Griffin's work (*On Functional Affections of the Spinal Cord.*) Dr. Griffin even supposes that there is a special

relation between the organs affected and certain parts of the cord: thus, that palpitation, vomiting, inordinate hunger and thirst, epigastric pulsation, and cough depend on affections of the cervical region; disorders of the stomach and colon, loss of voice, pain in the chest and arms, on those of the dorsal region; whilst irritation of the lumbar portion produces affections of the hip joint, colic, menorrhagia, ischuria, constipation, or paralysis of the legs. Such a relation may, no doubt, often be observed; but considering the close connexion of the different parts of the spinal cord, we need not be surprised to find frequent deviations from the rule. Much caution is required in the treatment of these affections, the hysterical susceptibility of the cerebro-spinal system being associated with a peculiar sensitiveness to any disturbance of the balance of circulation, whether on the side of excess or of deficiency. When the strength has been good, we have repeatedly witnessed great advantage from the application of a few leeches to the tender part of the spine, and subsequently from counter-irritation by blisters or tartar emetic ointment; and have known a case of vomiting, apparently hysterical, of two years' duration, yield in a few days to this simple treatment. In cases associated with isolated affection of the spinal cord, two blisters, one on each side of the part, are the best counter-irritants: when the affection is more extensive and chronic, antimonial ointment is probably more effectual. Palpitation of the heart and teasing cough may often be relieved by the same means. The cough is temporarily relieved by antispasmodics, as ether; more completely by a combination of ammoniacum and prussic acid; but counter-irritation can rarely be omitted, and sometimes a slight course of mercury is essential.

In cases of spasmodic closure of the glottis, cold water should be thrown on the face, and ammoniacal salts applied to the nostrils. The fauces and pharynx may be tickled with a feather or with the forefinger, the retching, and consequent expiration thus induced, engage the laryngeal in one combined act with the other respiratory muscles, and the spasm of the glottis is thus overcome.

In the epileptic form of hysteria with spasmodic closure of the jaw, we may often succeed in opening the mouth by firmly compressing the muscles attached to the hyoid bone. Mr. Laycock supports this recommendation by mentioning a case of spasm of the glottis in an adult male, in which inspiration immediately followed pressure of the thyroid cartilage. (*Med. Gaz.*, 1838.) If this method fail, the object may sometimes be accomplished by forcibly overcoming the tetanic flexion of the forearm and fingers. The relief thus obtained may be temporary, but it gives an opportunity for the administration of valerian or assafoetida. Hysterical hiccough is occasionally relieved by the same measures which prove useful in cases of cough and palpitation: one case, however, of a severe character, which had lasted for weeks, and continued during sleep, resisted this method, but was cured by a blister to the epigastrium.

In the class of cases under review the author has given a trial to veratria in the form of unguents, but it has not appeared so effectual a counter-irritant as the tartar emetic ointment.

When a *tympanitic state of abdomen* appears to depend on the condition of the spinal cord, turpentine is often useful; and when this remedy has failed, alum in considerable doses has accomplished a cure. Dr. Abercrombie has referred to some interesting cases, probably of this class, in which the application of galvanism proved remarkably efficacious. This agent is perhaps peculiarly suitable when the tympanic condition depends on partial paralysis of the muscular coat of the bowels. In all cases of this class it is essential to obviate hepatic congestion, and to prevent intestinal accumulation. The long-continued use of a stimulating embrocation rubbed freely along the whole course of the spine is a valuable auxiliary; and when the more urgent symptoms are removed, exercise, whether on horseback or on foot, tends to lessen the morbid susceptibility, and probably the disposition to congestion. In most hysterical cases the long-continued use of mercury is greatly to be deprecated, although occasionally necessary, as in the treatment of some cases of obstinate barking cough.

To the class of cases depending on spinal congestion may probably be referred many instances of diminished power of volition, some of which also follow mechanical injuries of the spine. In these cases medical treatment accomplishes little, but some sudden moral excitement seems occasionally adequate to rouse the voluntary power, and to transmit its influences to the muscles. It is chiefly on these cases that alleged miracles, such as those of Prince Hohenlohe, have been wrought.

2. The *atonic* variety of idiopathic hysteria is most frequently witnessed in patients who, on account of some severe disease, have undergone free depletion, or taken mercury to excess; as, for example, in the course of treatment required for the rapid ulceration of the cornea; and it is interesting to observe, that the change to the tonic plan is generally as useful to the local complaint, as it is essential to the control of the hysterical malady.

In some of these instances tenderness occurs in the spine, but it generally exists also in other parts of the body. It is aggravated by leeching, which may even be followed by paralysis. It is not uncommon to witness great cerebral excitement, sleeplessness, throbbing of the carotid and temporal arteries, and intolerance of light and sound. Such cases are sometimes unhappily mistaken for phrenitis; but the sudden changes in the severity of the symptoms—the pulse not being characteristic of alarming local disease—the existence of other hysterical complaints, as tympanic abdomen, urgent pain of various parts, particularly under the left mamma, and the production of the disorder by some mental excitement—soon disclose its true nature. The mistake is, however, too often committed, and is of serious consequence, since injudicious depletion aggravates all the symptoms, and may even produce permanent mania, whilst it always retards, and sometimes prevents, ultimate recovery. On the other hand, the application of cold to the head, the use of mild anodynes, such as camphor with extract of henbane, or, if they fail, morphia, with perfect quietness, soon dispose to rest; after which the nitrate of silver, in half-grain doses, exerts a most favourable influence on the morbid sensibility. Should the debility continue long, and the symptoms assume an intermittent character, the sulphate of quinine will be found a valuable auxiliary; or if there be pallor, with neuralgic symptoms, the sesquioxide of iron. Some of the chalybeate mineral waters, as the Eger, Pyrmont, or Spa, and exercise in dry country air, will materially promote the recovery of strength. The use of the shower bath is an important auxiliary to the tonic plan, its influence on the cutaneous nerves producing a most favourable effect on the nervous centre.

Secondary or sympathetic hysteria is generally associated with derangement of the intestines or the uterus, to which parts it will therefore be necessary to direct the chief attention. We cannot be surprised that impressions made on the delicate extensive plexuses of the intestines should powerfully affect the nervous centre. A striking example of the power of such impressions in producing hysterical symptoms is given by Brachet. On two different occasions, at intervals of nine months, a woman, who had never before exhibited any phenomena of the disease, took food which, without her knowledge, contained cheese, and each time fell into an hysterical paroxysm, which was relieved only by vomiting. The symptoms exhibited, and the treatment required, in hysteria from intestinal derangement, vary according to the peculiar nature of that derangement. For practical purposes it will be sufficient to consider it as associated with *intestinal irritation*, or with *intestinal torpor*.

The first class of cases, those arising from intestinal irritation, often partake of an inflammatory character; the abdomen is distended and rather tender; pain is felt after taking food, especially when of an indigestible kind; the tongue presents large red papillæ, and there is much thirst. Eruptions arise on the skin from slight causes; sleep is much disturbed; any indigestible substance detained in the stomach, such as cheese or potatoe, will occasionally produce terrific palpitation of the heart. Intense gastrodynia occurring in paroxysms, particularly

in the morning, is not uncommon. The hysterical phenomena attending this condition are exceedingly irregular. Perhaps the most usual indications are attacks of violent headach, strong and variable emotions, and a disposition to laughter, or excessive weeping on slight occasions. In these cases if the tenderness of stomach be considerable, leeches are in the first instance necessary; afterwards great benefit is derived from cooling saline medicines combined with hydrocyanic acid. If there be much flatulence, and especially if the urine (which is very common) appears muddy, a few drops of Sp. Ether Nitr. may be added to each dose with advantage. The catamenia are apt, in these cases, to be profuse, and accompanied with much pain of back and head. These symptoms are materially relieved by rest, and small doses of Liquor Ammon. Acet. Aloetic and all irritating purgatives must be carefully avoided. Castor oil is almost the only aperient which can be borne. When the paroxysms of palpitation and flatulent colic are urgent, the assafœtida enema will often give relief. Morphia sprinkled on a blistered surface, applied to the præcordial region, will often quiet the heart, and sooth the stomach. Stimulants of every kind should, as far as possible, be avoided, since the temporary relief afforded by them does not compensate for the prolonged suffering which the sub-inflammatory state of the digestive organs, thereby induced, is calculated to occasion. The diet must be regulated with great care. In the attacks of gastrodynia which occasionally attend or follow the condition just described, we have found great benefit from the use of small doses of sulphate and sesquicarbonate of soda combined with an aromatic.

In some instances there is no evidence of general irritation; the tongue is perhaps pale. The symptoms are almost limited to the stomach, which rejects food; and the occasional occurrence of globus is the chief indication of hysteria. The epigastrium may be tender, but the feeling after taking food is one of oppression rather than of pain. In these cases hydrocyanic acid is a remedy of great value, but is better combined with mucilaginous mixture than with salines. A few leeches, followed by counter-irritation, and a strict adherence for a time to farinaceous diet, shortly change the character of the complaint. The sickness attending this state of stomach, when not removed by prussic acid, is sometimes curable by creasote, but the remedy is too stimulating for indiscriminate use, and the nitrate of silver would often be preferable.

Globus, palpitation, and the hysterical condition of mind, are occasionally accompanied by hæmorrhoids. In these cases hepatic congestion is generally present. The mercurial pill in half-grain doses, continued for some time, is useful; and if paroxysms of flatulent colic occur, a combination of valerian and opium.

2. Hysteria associated with intestinal torpor is generally observed in those who lead a sedentary life, and whose constitution is by no means delicate. A constipated state of bowels is well known to disturb the functions of other parts, to weaken the organic energy, and to predispose to hysteria, which, when combined with this state, generally assumes the regular form. Here it is obvious that a judicious purgative plan is strongly indicated; and an emetic of ipecacuanha will frequently prevent a threatened paroxysm. This variety is usually complicated with amenorrhœa, and the remarks made under that complication will bear more or less application to the present one.

The *second leading division* of the *sympathetic* disease is that connected with *uterine derangement*, and in a practical point of view there are three important conditions with which it may be associated, namely, menorrhagia, defective menstruation, and leucorrhœa.

1. Hysteria accompanied with menorrhagia is particularly apt to occur in those who have had frequent miscarriages. When there is reason to believe that the complaint is passive, and that the hysterical affection is dependent on the debility thus induced, it is necessary to check the discharge by means of sulphuric acid or alum. The acetate of lead may perhaps have a more decided effect, but we

have observed a greater tendency to colic from its use in hysterical persons than in others. If there is general or local irritation, sulphate of magnesia dissolved in infusion of roses will be useful; and during the catamenial period, cooling saline medicines, especially the acetate of ammonia, should be employed. Dry air, rest, and freedom from excitement, are essential to the cure.

2. When hysteria is associated with defective menstruation, some of its most decided and prominent features are presented; and this variety of the disease has therefore attracted peculiar notice. Tate has even restricted the term hysteria to this class. The catamenial secretion is scanty, irregular, or unnatural in appearance. The patient does not generally complain of pain in the back, but on examination the spine is almost always found tender, especially near the sixth upper dorsal vertebræ, with headach, aching of the loins and legs, and pain under the left breast. The bowels are commonly confined, the tongue is furred, and the pulse variable. Stupor, palpitation of the heart, and suspended respiration, are occasional phenomena. Hysteria thus associated usually exhibits a remarkable influence on the motor system of nerves. The paroxysm is decidedly convulsive, and contractions of the limbs may occur, especially at the catamenial period. Cases of hysterical catalepsy, chorea, and paralysis, are generally referrible to this division.

In the *treatment* of this variety the restoration of the catamenial secretion to its natural state is important, but not alone sufficient to effect recovery, since, especially when this depraved catamenial condition has been produced by mental causes, the attendant hysteria will often remain after the uterine function is re-established. Unless the patient is very delicate, cupping or leeching the tender part of the spine will be expedient, and in some cases bleeding is necessary. Subsequently counter-irritation by means of antimonial ointment, and active purgatives, with which, if the face be pale and the circulation languid, iron may be combined, constitute the leading points of treatment. When the catamenial period approaches, especially if indicated by pain of the back, headach, and general uneasiness, a few leeches to the labia or thighs, and the mustard pediluvium, will promote its occurrence. A single dose of calomel, digitalis, and aloes, followed by an active aperient, as recommended by Dr. A. T. Thomson, and subsequently the use of pills of aloes and myrrh with galbanum, once or twice daily, powerfully contribute to re-establish the uterine action. The transmission of electrical shocks through the pelvis has considerable efficacy in correcting flatulence, promoting alvine evacuation, and exciting the catamenial function. During convalescence, active exercise and the use of the shower bath are requisite, and the general principles of treatment which have been repeatedly proposed must be duly observed.

3. The last variety of sympathetic hysteria, namely, that associated with leucorrhœa, or depending on chronic uterine irritation, is one of great importance, owing to its frequent occurrence and its liability to be overlooked. The sufferer complains of debility, her movements are languid and her spirits depressed, and she weeps on slight occasions, but makes no specific complaint. The appetite is bad, and the tongue is often fissured, the clefts being filled with a viscid secretion. Globus hystericus occurs from time to time, with tenderness of loins and sacrum, pain under the left mamma, neuralgic affections in the region of the stomach, along the margin of the ribs, on the right side, or throughout the abdomen generally, and often a flatulent state of the bowels, especially of the colon. The usual causes are, active exertion during the catamenial period, mental anxiety, or undue excitement, sometimes incidental to matrimony. In these chronic uterine affections the urine generally deposits the triple phosphates, while in the more acute and regular forms it is watery and contains little urea.

The *treatment* which we have found most effectual is a dose of mercurial pill and extract of hemlock, followed by castor oil with tincture of henbane, and afterwards saline medicines combined with prussic acid, tincture of henbane, and spirit of nitric ether. The frequent use of mercury, even in small doses, is to be depre-

cated, as it increases the irritability of the system; but an occasional dose relieves congestion and improves the secretions. After a time astringent lotions may be used, such as the Liq. Aluminis Comp. Sexual excitement must be avoided, and every measure employed which is calculated to strengthen without stimulating. The use of tonics must not be rashly or hastily adopted. Chalybeates are generally too exciting, and even quinine cannot always be borne. The sulphate of zinc is occasionally useful; and in some instances, especially when there is a catamenial deficiency, the artificial Kissingen water, prepared at the German Spa at Brighton, is of remarkable service in relieving from the sensation of weight after food, correcting the tendency to flatulent colic, and regulating the uterine function. It removes local congestion, especially of the uterus, and is peculiarly adapted to derangement of this organ associated with fibrinous catamenia. The affection of abdomen attending this form of the malady sometimes greatly resembles peritonitis, but superficial is as painful as firm pressure. The countenance is less anxious and distressed than in peritonitis, and the variable and diffused character of hysteria is easily recognised. Sometimes, however, there is sufficient uterine inflammation associated with this state to authorize a single bleeding, though the effect must be carefully watched, and undue depletion avoided.

Most of the neuralgic affections which we have seen associated with hysteria have been on the left side. For the relief of pain under the left mamma, between the cartilages of the fifth, sixth, and seventh ribs, and which appears to be of this character, Mr. Tate and Dr. O'Beirne place great dependence on tartar emetic ointment rubbed over that portion of the spine which supplies this part with nerves, and Dr. Copland has found benefit from the moistened inner bark of meze-reon worn for some time, so as to produce a superficial sore. The sesquioxide of iron is often serviceable after the other symptoms of irritation have subsided, but its efficacy is much promoted, in many cases, by the previous application of leeches. The painful affection of the abdomen may sometimes be relieved by a warm flannel dipped in spirits of turpentine. A careful observer cannot mistake for hepatic disease, the shifting and uncertain pain in the right hypochondrium which often attends this variety of hysterical complaint. When neuralgia of the uterus itself is present, according to Lisfranc, the cervix is tender, and possesses the form and size characteristic of the second month of pregnancy.

Hysterical affections of the joints, which have been so well described by Sir Benjamin Brodie, are frequently but not invariably associated with the same variety. In some cases those of the knee so closely resemble in the symptoms, ulceration of the cartilages, that it requires much time and care to form a correct diagnosis; but in hysterical affections the limb is often extended, whereas in diseases of the cartilages it is usually bent; in addition to which, the previous history of the case will frequently solve the problem. In these cases blistering is in general useless, and confinement injurious. The belladonna plaster is less useful in this than in other forms of hysterical neuralgia. Sir Benjamin Brodie has found the pain palliated by a tepid lotion, consisting of equal parts of Sp. Rosmarini and Mistura Camphoræ; and when the limb is liable to alternate heat and cold, by a cold spirituous lotion during the hot fit, and during the cold one by a worsted stocking covered with oiled silk, so as to confine the heat and perspiration. The intermittent character of the symptoms indicates the administration of the sulphate of quinine.

Marriage has been by some authors recommended as a remedy for hysteria; but the preceding remarks will show that it is quite as likely to aggravate the complaint as to cure it: and where it does prove a remedy, it is probably rather by satisfying the affections of the heart.

Hysteria frequently occurs in persons of a gouty constitution, by which it is somewhat modified; and in these cases colchicum merits a trial.

Those who have long suffered from hysterical complaints, have frequently a tedious convalescence, with various distressing affections of the stomach, nerves, mind, &c.; but provided the recovery is progressive, it is better not to interfere

too actively. Exercise, country air, and useful occupations, gradually restore the health; and in the absence of any distinct indications of treatment, the advice of Sydenham is peculiarly valuable, "If you cannot do good, do nothing."

In the *moral management* of hysteria it is important to temper kindness with firmness, and to avoid a parade of sympathy. A due intercourse with society, which diverts without exciting, is desirable. It is of great importance to remember that hysterical susceptibility is perhaps, in a majority of instances, the result of injudicious management in early life. The many excellent works published of late years on the subject of physical education, are already attracting deserved attention and contributing to correct this evil; nevertheless, in the upper ranks of society, young females are still pampered with stimulating food, and injured by modes of dress which unduly compress the most important viscera. Too much time is still devoted to sedentary employments, and the perusal of the works of fiction is too often substituted for solid attainments, by which a fondness for injurious excitements is naturally promoted, instead of a salutary habit of self-control. It was never intended by Providence that every woman should be a musician or a painter, but it was undoubtedly designed that she should cultivate those substantial qualities of sense and temper which give permanence and freshness to the charms of domestic life. During early youth, the mind must not be allowed to outstrip the body; exercise and fresh air strengthen both, and in favourable weather the house should often be regarded rather as a retreat than as a dwelling-place.

T E T A N U S.

Explanation of the term tetanus and its varieties.—Trismus.—Opisthotonos.—Emprosthotonos.—Pleurosthotonos.—Trismus nascentium.—General and local.—Acute and chronic.—Idiopathic and symptomatic.—Continued and periodic.—Premonitory symptoms of tetanus.—Symptoms of the paroxysm of trismus, of opisthotonos, of emprosthotonos, of pleurosthotonos.—Chronic forms of tetanus.—Predisposing causes.—Exciting causes.—Anatomical characters.—Nature.—Diagnosis.—Prognosis.—Treatment.

THIS term (derived from *τείνω*, to stretch) denotes a disease, the principal characteristic of which is tonic spasm of a certain number of muscles. Some authors have restricted its meaning to that form in which, by the muscular spasm, the trunk is kept perfectly straight, and employ other terms to designate the disease when any particular set of muscles are more especially affected. Thus, if the muscles which raise the lower jaw be in a state of contraction, it has been denominated *trismus*, (from *τριζω*, to gnash;) if those attached posteriorly to the spine be affected, so as to draw the body backwards, *opisthotonos*, (from *οπισθεν*, backwards;) if the muscles of the neck and abdomen be contracted anteriorly, in such a manner that the trunk is inclined forwards, *emprosthotonos*, (from *εμπροσθεν*, forwards;) and if the muscles are affected laterally, so that the body is curved sideways, *pleurosthotonos*, (from *πλευροσθεν*, sideways.) In all these forms, however, the disease is essentially the same, and at present the above terms are only used to express the distortion or particular posture produced. When it occurs in infants it is called *trismus nascentium*. Some writers divide tetanus into *general*, when the whole muscular system is affected; and *local*, when there is rigidity of one or several muscles, as in cramp, priapism, &c. Tetanus has also been distinguished, as regards its duration, into *acute* and *chronic*, though the limits where the one terminates, and the other begins, have not been fixed. Two varieties have also been established, the *idiopathic* and *symptomatic*; the former arising from causes acting directly on the nervous system, the latter from the irritation in other organs being propagated indirectly to the nervous centres. Thus tetanus following wounds (termed *traumatic*) belongs to the latter variety. It has also been divided into the *continued* and *periodic*: in the former the rigidity does not disappear entirely, but the symptoms sometimes suddenly increase; in the latter there are complete intervals or interruptions of the tetanic rigidity—the symptoms in some cases recurring at stated or fixed periods. The *continued* forms are always acute or sub-acute, the *periodic* always chronic. Dance has recorded four cases of the latter variety. (*Dict. de Méd. et Chir. Prat.*) Hufeland has also seen a case that for years returned at regular periods, which lasted eight hours. (*Manuel de Méd. Prat. par Jourdan.*, p. 234.)

Symptoms. The symptoms of tetanus vary according to the severity and duration of the disease, and the particular set of muscles affected. It sometimes comes on suddenly, without any signs to indicate its approach. In general, however, one or more of the following premonitory symptoms have been observed, viz: sadness; languor; unusual melancholy and depression; unwillingness

to speak or move; restlessness or uneasiness; watchfulness; headach; yawning; loss of appetite; bitter taste in the mouth; foul tongue; constipation; unpleasant sensation about the præcordia; pains in the back; a dry tumid skin; unusual extension of the limbs during sleep, and sometimes a strange sensation of terror. According to Larrey, traumatic tetanus is announced by deep pains in the wounded part, extending to the spine, and in some cases twitchings of the limb have been observed to precede the attack.

The above symptoms are, however, common to many disorders; but in chronic cases of an epileptic character, where a distinct interval more or less prolonged takes place between the paroxysms, one or more of the above signs indicate with tolerable certainty an approaching attack.

The tetanic symptoms may be said to commence with a feeling of stiffness in the muscles of the jaws, throat, or neck, attended with difficulty of swallowing. There is a constraint in flexing or rotating the head, and in opening the jaws. In general this latter symptom, or the trismus, comes on gradually, accompanied with uneasiness or pain in the muscles affected, when the inferior maxilla is by degrees drawn against the superior, and at length so firmly closed that it is impossible to separate them. Sometimes, however, this occurs suddenly, and the jaws are violently snapped together, and remain firmly clenched. Violent and acute pain is now felt below the sternum, sometimes of a darting or stabbing character, extending to the spine, or there is a sense of traction or constriction in this situation. If the rigidity extend to the muscles of the trunk and extremities, the complete paroxysm is manifested. At this time the face is sometimes pale, but usually flushed, the veins being full and prominent; the brows are contracted; the skin covering the forehead corrugated; the eyes fixed and prominent; sometimes suffused with tears; the pupils stationary, generally contracted, but sometimes dilated; the alæ of the nose elevated, and the nostrils expanded; the angles of the mouth drawn outwards and upwards, sometimes downwards, so as to produce the most frightful *risus sardonius*; the tongue fixed and immoveable, and the whole countenance expresses the greatest pain and anxiety. Sometimes a frothy saliva is squeezed out between the teeth, and flows from the mouth; in other cases the tongue is thrust forwards and lacerated, giving rise to considerable hæmorrhage. The larynx is raised; the articulation indistinct and painful; sometimes the power of articulation is lost, all attempts to speak apparently aggravating the paroxysm. The muscles generally are tense, rigid, and often feel as hard as a board; the shoulders are drawn forwards, and the trunk and extremities firmly fixed in various positions, afterwards to be described, or violently thrown about by occasional momentary relaxations, followed by sudden muscular contractions of longer or shorter continuance. The respiration is hurried, and performed with great difficulty and anguish, presenting to the spectator one of the most distressing forms of dyspnœa. The patient often feels great thirst, but all attempts at swallowing produce extreme agony, and spasms of the muscles of deglutition; symptoms allied to those of hydrophobia being thus occasionally produced. The pulse at the commencement is full and hard, but gradually becomes feeble and frequent, sometimes intermittent or irregular, according to the continuance and severity of the attack. The temperature of the skin, is increased, and the surface covered with a profuse perspiration, which in certain instances is confined to the face and chest. Occasionally the urine is expelled with violence, but sometimes there is retention. The sphincter ani in general is firmly closed, but in some cases the fæces have been expelled involuntarily. In the midst of all these sufferings the intelligence is unaffected—a circumstance which increases the distress with which the by-stander must naturally regard them.

Such are the general symptoms which characterize the paroxysm in its severe acute form; but there is considerable variation, according to the peculiar class of muscles more especially affected. When the disease is confined to the levators of the lower jaw, constituting *trismus*, some time may elapse before other muscles

become affected; in this state the malady may disappear, or it may prove fatal. When the disorder, however, is more severe or advanced, trismus supervenes, which may be considered only as a mild or partial form of the general disease. *Opisthotonos* is occasioned by the posterior muscles of the spine being powerfully contracted, the effect of which is to draw back either the head and neck alone, or to curve the trunk into the form of an arch, the body resting only on the occiput and sacrum, or on the vertex of the head and heels, if the lower extremities be affected. The force and suddenness with which this is produced, is sometimes sufficient to throw the patient out of bed. Fournier Pescay has seen dislocation of the second cervical vetebræ, and Desportes, fracture of the thigh bones from the excessive muscular action. Larrey and Curling also relate cases in which one of the *rectoabdominalis* muscles was ruptured. *Emprosthotonos* is produced by the muscles on the anterior part of the body being most powerfully contracted, so that the head is flexed upon the breast, the thighs on the abdomen, and the trunk curved forwards. In severe cases the head and knees approach each other, the arms are flexed, and the hands sometimes clasped together. According to Larrey the legs are rigid and flexed upon the thighs, but Aretæus describes them as being extended. *Emprosthotonos*, however, is a very rare form of tetanus, and it is to the experience of Larrey in modern times we are chiefly indebted for its description. In *pleurosthotonos*, the neck and trunk is curved towards one side; this form is so rare, that some writers have doubted its existence.

Occasionally the whole body is perfectly rigid and straight, no particular set of muscles apparently being more affected than another. To this state some physicians consider the term *tetanus* ought to be restricted.

The dreadful symptoms described may terminate in death, or they may gradually cease, and the patient return to his natural condition, or to a comparative state of ease. In the former case the various symptoms increase in intensity: the dyspnœa becomes more urgent; an agonizing sense of suffocation is felt; the perspiration becomes cold and clammy; the pulse thready or imperceptible; a frothy, bloody mucus escapes abundantly from the mouth; the countenance assumes a livid hue; the spasms increase in frequency, and are renewed by the slightest attempt to move or swallow, or by any trivial circumstance, such as opening the door, a draught of air, &c.; delirium sometimes supervenes, and the patient sinks either asphyxiated or exhausted from the efforts and pain of the paroxysm. Sometimes the individual dies suddenly after an amelioration of the symptoms. When the disease terminates favourably, the rigidity gradually lessens, the spasms are less frequent, the respiration becomes more free, and the pulse natural; and although there is for some time a feeling of stiffness or soreness in the muscles, the patient gradually returns to the state in which he was before the seizure. The duration of acute tetanus varies. A case is recorded of a negro, who, having scratched his hand with a piece of broken plate, died of tetanus in a quarter of an hour. (*Rees's Cyc. art. TETANUS.*) The fatal termination usually takes place from the fourth to the eighth day, but cases have been reported which continued to the fourteenth and even to the twentieth day. (*Morgagni.*) On the other hand the recovery is generally slow. Of 58 cases collected by Curling, which terminated successfully, 8 recovered in a week; 3, in 10 days; 4, in a fortnight; 4, in three weeks; 15, in a month; 4, in 5 weeks; 8, in 6 weeks; 3, in 8 weeks; 3, in 2 months; and 2 so late as 3 months. Greater or less rigidity of certain muscles may remain for many months, and in some cases a peculiarly aged character is given to the countenance.

The chronic form of tetanus is characterized by the same symptoms, but they come on more gradually, and there are sometimes shorter or longer intervals between the paroxysms for several months or even years. There does not seem to be any very clear division between the acute and chronic forms. Dr. Symonds thinks a sub-acute form should be constituted, including those cases which are of mild character, but which do not continue long enough to be designated chronic.

But however we multiply the divisions, intermediate cases will always be found, which no arbitrary classification can comprehend.

Many of the symptoms are liable to various modifications in particular cases, or at different periods of the disorder. The muscular system, as we have stated, may be so affected as to produce trismus, opisthotonos, emprosthotonos, or pleurosthotonos. Cramp also is a slight modification of the disease, and during the paroxysm all the muscles are more or less spasmodically affected. The contraction of the pectorals draw the shoulders forward, and the rigidity of the respiratory muscles prevent the free motion of the chest. In trismus, although the jaw is closed, the anterior muscles of the neck appear hard and contracted, and in opisthotonos the walls of the abdomen are stretched, and feel as hard as a board, showing that the peculiar distortion produced is not the effect of a particular set of muscles only being affected, but that their power is increased, or that they are acted on to a greater degree than others. The muscles of deglutition are peculiarly liable to be excited on the slightest contact, producing inability or difficulty of swallowing, and in severe cases horror of fluids, and symptoms resembling those of hydrophobia. In some instances it has been observed that the cremasters participate in the disease and draw up the testes. The eyeball is always fixed, and sometimes from irregular action of its muscles drawn inwards. During sleep the muscles are relaxed, and it has been observed in many cases that, during the whole course of the disease, those of the fingers have not been affected. The voluntary muscles principally suffer, though several authors are of opinion that the involuntary are also occasionally affected. It must be evident, however, that tetanic spasm of the heart, diaphragm, &c., must soon be followed by death; and although certain symptoms indicate that they are in some way or other acted on, the manner in which they are affected is unknown.

The sensibility to touch is not increased in tetanus, but in many cases the slightest contact, or even noise, is sufficient during the remission to bring on the spasms. The pain experienced in particular muscles is sometimes very great, especially in those which have been injured by a wound. In a case however given by Sir G. Blane (*Obs. on Diseases of Seamen*) a pleasurable tingling sensation was experienced. In almost every instance of tetanus, great pain is felt in the præcordial region or below the sternum, which has been denominated by Dr. Chalmers the pathognomonic symptoms of tetanus. It is described as being of a dragging nature, occurring suddenly, and darting towards the back, and not increased by pressure. In some cases it appears early in the disease; in others at a later period, and is attributed to the diaphragm partaking in the general spasm.

The intelligence is in the great majority of cases clear and unchanged. Some instances are recorded however (and we have seen a remarkable one of this kind,) in which the consciousness was completely lost. Under such circumstances the disease may be called epileptiform.

The pulse in tetanus varies according to the stage of the disease. Morrison, Hennen, Macgregor, and others, have noticed that it was not much affected. In the early stage there is no remarkable acceleration; but during the spasms, it is somewhat quickened; and as the disease approaches its fatal termination, it becomes weak, frequent and thready. Dr. Parry thought that the patient was safe if the pulse did not exceed 110 beats on the fourth or fifth day. No dependence however can be placed on this symptom as a prognostic, many cases having died when the pulse was more slow, while others have recovered when it was more frequent. The temperature of the surface is generally increased, and sometimes the skin feels hot. M. Prevost of Geneva had a case in whom the temperature at the axilla was 110° (Fahrenheit.) and Dr. Bright another, in whom it was 105°. The cutaneous transpiration is increased, which may be attributed to the violent muscular exertion into which the patient is involuntarily thrown. Sometimes there is a slight miliary eruption. There is occasionally fever, more commonly in idiopathic cases, but sometimes also when it arises from wounds: many writers however, who have

seen much of the disease, have never observed this. The tongue is moist at the commencement, but becomes dry as the disease proceeds. Constipation is almost a uniform symptom in tetanus: this has been attributed to many causes, as spasm of the muscular coat of the intestines, excessive cutaneous transpiration, pressure of the diaphragm and abdominal muscles, loss of the voluntary power necessary for defæcation, the use of opium, and other constipating remedies, &c. Retention of urine occurs occasionally, and in such cases there is much difficulty in introducing a catheter, from the spasmodic action of the muscles at the neck of the bladder. The urine is generally high-coloured and scanty.

Causes. Men are more liable to tetanus than females, a circumstance which is accounted for by the former being more exposed to the exciting causes of the disease. Tetanus is common in early infancy; the term *trismus nascentium* has been given to the disease, when it occurs at this epoch of life. After this period, however, it occurs most frequently between the ages of ten and fifty. Extensive observation has shown that it is very rare in advanced life, although Aretæus thought it readily developed in old persons.

It is a well-established fact, that notwithstanding tetanus may occur in all climates, it is most common in those of an elevated temperature, and more frequent when the season is hottest. Army and navy surgeons, who have practised in the East and West Indies, have proved this, although we possess no statistics which enable us to speak decidedly as to its proportionate frequency. Moist situations also predispose to the disease. In the French hospitals at Cairo, which were erected on ground subject to the periodic inundation of the Nile, it was very frequent. It is said also to be more common in marshy situations and countries bordering upon the sea, than in dry and elevated places far from the coast.

The strong, robust, and athletic, have been noticed as being more liable to the disease than weak persons, or those in ill health. It is also more common in individuals of a nervous, than in those of a lymphatic temperament. Campet, Dazille, and Anderson, have noticed that tetanus is much more common among the negroes than among the white population, a circumstance which has by some been imputed to an inherent predisposition, and by others to their more frequent exposure to the exciting causes. Insufficient nutriment, close and ill-ventilated habitations, uncleanliness, and neglect of the bowels, powerfully predispose to this disease. Drs. M'Arthur and Dickson have shown, that since these evils have been remedied, a marked diminution in the frequency of the disorder has occurred in the West India department of the navy.

The most frequent *exciting* causes of tetanus are external injuries, and it appears that the most unimportant superficial abrasion, and the most serious operation may give rise to the disease. It has been occasioned by a bite on the finger from a tame sparrow (*Morgagni*;) the stroke of a whip lash under the eye, although the skin was not broken (*Reid, on Tetanus and Hydrophobia*;) a fish bone sticking in the pharynx (*Larry, Mem. Chir. Mil.*, tom. i. p. 254;) a seton in the chest (*Andral, Clin. Méd.*, tom. iv. p. 445;) the stroke of a cane on the neck and hand (*Morgan, on Tetanus*, p. 6;) flagellation; extraction of a tooth (*Edin. Med. and Surg. Journ.*, vol. xv.) cupping, venesection, &c. It has also followed severe fractures, lacerations, contusions, punctures, amputations, excision of the mamma, tying arteries, gun-shot wounds, castration, injection for hydrocele, &c. An instance is related where it followed the bite of a horse in the arm (*Boyer*, tom. i. p. 287,) and another in which it was occasioned by stretching a nerve. (*Swan, on the Nerves*, p. 541.) A wound in any part of the body may produce tetanus, although it has been observed more frequently from injuries of the extremities, than from similar injuries of the head or trunk. In 128 cases of traumatic tetanus, collected by Mr. Curling (*Essay on Tetanus*,) the wounds occurred on some part of the lower extremities in 64, and on the upper extremities in 46, and of these the feet and toes were the seat of injury in 35, and

the hands and fingers in 34. Dr. Hennen observed it most frequently after wounds of the elbow and knee, and others when the thumb or great toe was injured.

Some authors have noticed a peculiar state of the wounds in connexion with tetanus. Rush remarked that they were always free from inflammation (*Med. Inquiries*, vol. i;) Larrey, that they were either dry, or covered with a thin serous exudation; and Fournier Pescay describes them as being pale, livid, sometimes covered with an ichorous secretion.) (*Dict. des Sc. Méd.*, tom. lv.) Sir J. Macgregor and Dr. Hennen, however, after great experience in this disease, conclude that there is no relation between the state of the wound and the occurrence of tetanus. They have seen it occasioned by all descriptions of sores, healthy and sloughing, incised and lacerated, simple and complicated. Neither does its accession produce any alteration in the wound, or retard its progress towards a cure; and in many cases it has been completely healed and forgotten before the occurrence of the tetanic symptoms. Dr. Elliotson observes that the disease has sometimes declined and ceased, while the wound every day grew worse and worse.

The interval between the infliction of the injury and the commencement of tetanus differs considerably. In a case related by Dr. Robison, (*Rees's Cyc.*, art. TETANUS,) it followed immediately; the longest period on record is ten weeks; the case is detailed by Mr. Ward. (*Facts establishing the Efficacy of Opiate Friction in Spasmodic and Febrile Diseases*, &c., 1809.) In the 128 cases of traumatic tetanus collected by Mr. Curling, it appeared from the fourth to the fourteenth day in 81, and this is the most common period of its occurrence. The time after which an individual may be considered safe from tetanus when he has received an injury, is undecided, and has been differently stated by authors. Fournier Pescay says he has seen it occur after a month. Sir J. Macgregor never witnessed an interval longer than twenty-two days, and Sir B. Brodie longer than seventeen. Larrey thought that in Egypt the French soldiers were safe after the sixteenth day.

Exposure to cold and damp is a frequent exciting cause of tetanus, independent of any other circumstance. Numerous cases are related of individuals being affected after sleeping during the night in the open air, particularly in tropical climates, where the dew is abundant, and the nights cold. Hennen and Larrey have noticed its occurrence in Egypt, when the nights were chilly and rainy, and when the troops were exposed to cold and moist breezes from the sea. Sudden changes of temperature have in like manner been noticed by the last named authors, and by Dazille, Campet, and Rush. The latter writer informs us, that while no case occurred among the soldiers who had passed a winter in Rhode Island in 1781, it was frequent in some troops newly arrived from the West Indies. Bégin states, that after the battle of Muskowa, although the heat was very intense, no cases of tetanus occurred; whereas, after the battle of Dresden, when moist and cold weather succeeded a great elevation of temperature, it was common. Dr. Chalmers gives a case where it was brought on by sudden change of weather in a man who slept without his night-cap. Going into the external air from the heated atmosphere of a ball-room has also occasioned it. Fournier Pescay gives two instances where it followed the action of cold water on the body when in a state of perspiration, and one where it arose from exposure to the north wind, when the individual laboured under fever.

Intestinal irritation has occasioned the disorder: the presence of worms is one of its most frequent causes. Laurent (*Mém. Chir. sur le Tétanos*, 1797,) considered this almost the only cause of the disease; and in addition to the cases he has related, others have been recorded by Morgagni, Stoll, Fournier Pescay, O'Beirne, and others, where tetanus was apparently produced by vermination. It may also be occasioned by any other disorder of the digestive organs arising from improper food, irritating substances in the stomach or intestines, indurated fæces, &c. In infants an acrimonious state or retention of the meconium is a frequent cause, as well as irritation produced by the milk of the nurse.

Among the other exciting causes of tetanus have been observed great fatigue; terror; mental anguish; abortion; suppressed perspiration; cessation of the lochia, and other habitual discharges; intoxication; variola, typhus fever, gastric inflammation, and other acute diseases; retrocession of cutaneous disorders; lacerations and ulceration of the navel string; difficult and painful dentition; ulceration of the gums; irritation from the appearance of the dens sapientiæ; insolation; indigestion; constipation; rheumatism; hysteria; large doses of strychnine, nux vomica, &c.

It should be observed, that in many cases it is extremely difficult to determine the exciting cause, inasmuch as one or more of those we have enumerated may exist in the same individual, and in some instances the disease may probably be occasioned by their conjoined effect. Thus it has been noticed by almost every writer that tetanus is more frequent when individuals suffering from external injuries are also exposed to cold moist weather, or to sudden changes of temperature. The occurrence of fear and mental anguish under the same circumstances has often been thought by Hennen to occasion it. We can also readily understand that intestinal irritation or other causes may prove exciting causes, and that it may be attributed to an accidental scratch received before the accession of the symptoms. Hence many of those cases which are reported to have followed wounds several weeks after they have been received may have arisen from other causes of irritation, connected with the internal organs; and, on the other hand, it is possible that the wound which occasioned the disease may be overlooked.

Anatomical Characters. The morbid appearances found in those who have died labouring under tetanus are very various. Not unfrequently no morbid lesion whatever can be discovered to which the symptoms can be referred. With a view to illustrate the pathology of the disease, we shall describe the morbid alterations that have been observed, 1. in the brain and its membranes; 2. in the spinal cord and its membranes; 3. in the nerves; and 4. in other parts of the system.

1. Numerous cases have been reported in which the vascularity of the brain and its membranes was increased, the sinuses gorged with blood, the pia mater more or less injected, and the arachnoid cavity and ventricles more or less distended by serous effusion. These appearances have been occasionally observed by authors, who have had much opportunity of investigating the morbid anatomy of tetanus. Dr. Bright found an incysted abscess the size of a large nutmeg in the substance of the middle lobe of the brain (*Hospital Reports*, case 39,) and Bouillaud several tubercles, one of which was as large as an egg, in the right hemisphere (*sur l'Encephalite*.) Generally speaking, the substance of the brain is found healthy.

2. Alterations in the spinal cord and its membranes are by far the most common appearances found after tetanus, and in such cases there have generally been traces of spinal meningitis. These instances are too numerous to be spoken of individually. Several have been recorded by Reid, Kennedy, Brayne, and others in Britain; Larrey, Broussais, Magendie, Recamier, Ollivier, and others, in France; Bergamaschi, Brera, Bellingieri, Uralli, Poggi, in Italy; and Frank, Funk, &c. in Germany. Thomson (*Phys. Obs. on the Topography*, &c. Philadelphia, 1818,) and Göelis (*Salz. Med. Chir. Zeitung*, 1815,) have observed the same appearances in infants who have died of trismus nascentium. In some cases the inflammatory appearances were more or less diffused over the spinal cord, and in others recorded by Ollivier, Pelletier, and Curling, they were limited to particular portions of it. Burserius found a large quantity of viscid yellow serum under the outer covering of the medulla spinalis. Ollivier discovered in the dorsal region of a child a red, consistent fluid in the cellular texture, between the dura mater of the cord and walls of the spinal column, with serous effusion within the membranes, and an albuminous concretion covering four inches of the medulla of the cord. Bellingieri gives a case where blood was effused in the cellular tissue, exterior to the dura mater. Poggi and Combette, in addition to evidence of spinal

meningitis, have observed softening confined to the anterior columns of the cord. Bony and cartilaginous deposits have been occasionally found in the membranes covering the spinal marrow after tetanus. In some instances, on the other hand, no morbid appearances have been detected either in the cord or its membranes.

3. In traumatic tetanus, the nerves in the neighbourhood of the wound have often been found more or less injured, or to have undergone morbid alterations. In certain cases they have been contused, lacerated, partially divided, irritated by spicula of bone, or other foreign substances included in ligatures placed on arteries, or participating in the inflammation of the surrounding textures. In the latter case, the appearances have differed according as the inflammatory action was acute or chronic; injection, more or less intense, and softening, being evidence of the former, and thickening, induration, and discoloration of the latter. Lobstein (*De Nervi Sympathetici*, p. 152,) and Andral (*Clin. Méd.*, tom. i. p. 49,) have observed signs of inflammation or redness in the semi-lunar ganglion, and Swan (*Diseases of the Nerves*) has often seen the ganglia of the sympathetic system in general considerably injected—an appearance which has been occasionally observed by other authors.

4. Dupuytren found in an individual who died of opisthotonos the muscles gorged with blood and lacerated. Larrey and Curling give cases where one of the recti abdominis muscles was torn across. The pharynx and œsophagus were often seen by Larrey contracted, and their mucous membranes red, inflamed, and covered with a viscid reddish mucus. The large papillæ at the root of the tongue have occasionally been found thickened, and the mucous lining of the larynx injected and covered with frothy mucus. Andral gives a case where unequivocal marks of gastritis were discovered, and M'Arthur found in four cases inflammation of the alimentary canal, with a peculiar yellow matter covering the mucous membrane of the stomach and œsophagus, which in one case effervesced on being exposed to the external air. Worms have been discovered in the intestinal canal by Sauvages, Laurent, Larrey, O'Beirne, and others. The last writer states that distention of the cæcum and colon is a constant pathological appearance. In a case related by Mr. Howship the heart was much indurated, and presented considerable resistance to the knife.*

Nature. Numerous theories have been advanced to explain the different phenomena observed in tetanus, but as none of them appear to have been deduced from a sufficiently extended series of observations, they have been rejected as inapplicable to the end in view. We are unacquainted with any series of facts which explain why in some cases there should be trismus alone, and in others opisthotonos, or emprosthotonos, although in some few cases the increased vascularity of the spinal cord and its membranes have been circumscribed so as to involve more particularly the origin of those nerves which are distributed to the muscles especially acted on. These cases, however, are very rare, and observation has shown that in the majority of instances no such limited lesion can be discovered. That the motor portion of the fifth pair is morbidly stimulated in trismus, is highly probable, because we observe the muscles to which it is distributed are those principally affected. But the proximate cause producing the irritation is not always discovered after death. Larrey thought that emprosthotonos or opisthotonos was occasioned according as

* As in the majority of cases no morbid lesion can be discovered, and the alterations when they exist are extremely slight and irregular, it is very clear that no structural lesion is connected with tetanus. The alterations of tissue are purely accidental. I have examined with great attention the brain and spinal marrow of ten or twelve subjects, dead of tetanus, and could not detect any organic lesion. That is, there is no softening of the spine, or injection of its vessels beyond what is often found in the bodies of individuals who have died without spinal symptoms. The little experience of most physicians in examining the spine has led some into error in this matter, and induced them to admit the evidence of organic alteration on slight grounds.

the wound injured the nerves on the anterior or posterior part of the body, and that if the nerves in both situations were wounded, complete tetanus was established. Numerous facts, however, prove that there is no relation between the situation of the wound and the form of the disease. Bellengeri has brought forward an elaborate theory which consists in attributing to the cerebral hemispheres the power of producing one kind of motion, and to the cerebellum that of producing another. He considers that the former presides over flexion and adduction, and the latter over extension and abduction. This is what he denominates "nervous antagonism," by which he thinks all motions throughout the body are governed. Thus, according to this author, opisthotonos or spasmodic extension depends on some irritation or disease of the cerebellum and posterior columns of the spinal cord; while in emprosthotonos or spasmodic flexion, the hemispheres and anterior spinal columns are more particularly affected. These views, though they have been maintained with great ingenuity, are not only opposed to the physiology of the nervous system established by Sir C. Bell, but to the majority of pathological facts with which we are acquainted.

It has been stated in general observations, that irritation of any part of the nervous substance will increase the function dependent on the part irritated. In tetanus, the intelligence and general sensibility are affected, while the characteristic symptom of the disorder is referrible to an augmentation of motor influence. We are therefore led to conclude, that irritation of the tractus motorius is a pathological condition necessary for the production of tetanus. Partial pressure, it is well known, is capable of producing irritation, whether applied to the spinal cord alone, in the course, or to the extremities of a nerve, and we find that morbid alteration or injury of either has been known to induce tetanus. The present state of science, however, does not enable us to indicate what particular morbid lesion occasions this irritation, which, with a view to treatment, is a point of primary importance. When treating of spinal meningitis, we have seen that muscular rigidity is a diagnostic symptom of that disease, and the dissection of individuals who have died labouring under tetanus has shown, that a vascular state of the membranes of the cord is by far the most common morbid lesion discovered. In many cases, however, no appearance of inflammation or increased vascularity is to be discovered; and it has been thought by some, that these appearances are rather the effects than the cause of the disease. However we may speculate on this point, proofs are wanted to establish the correctness of either opinion; but as we know that congestion of the blood-vessels surrounding the cord will occasion partial pressure, and consequently irritation, although it may not leave any traces of its existence after death, it seems reasonable to suppose that such a state more frequently precedes than follows the tetanic spasms.

Pelletier and Bergamaschi attributed the disease to inflammation of the nerves of the part injured, extending to the spinal cord; and Mr. Swan having found the ganglia of the sympathetic system of nerves preternaturally injected, thinks that the various predisposing and exciting causes produced disorder of the digestive organs, which was communicated by the ganglionic nerves to the other parts of the nervous system. Either of these views are fully capable of explaining how in certain cases irritation may be induced in the spinal marrow; but observation does not warrant us in considering either one or the other the true cause of the disease. Indeed modern researches have not revealed to us what is the nature of the morbid lesion which gives rise to the irritation, and whether it be allied to inflammation or congestion is equally unknown.

It should be observed that tetanus rarely follows the infliction of a wound immediately, that its occurrence bears no relation to the severity or extent of the injury, and that it cannot be produced artificially, except by the administration of poisons containing strychnia or brucia. These facts lead to the inference that, besides the local injury, there is a peculiar state of the system hitherto unknown and unexplained, which favours the production of tetanus, inasmuch as mechanical irritation of the motor tract, or of a nerve, does not produce tonic spasm, but

convulsion. We have also been satisfied from experiments on the frog, that strychnia acts through the medium of the circulation, and not by direct influence on the nerves to which they are applied. A similar conclusion has been arrived at by other experimentalists.

It appears therefore that the great point with regard to the pathology of tetanus, is to determine the essential distinction between tonic spasm and clonic convulsion, and the agents which induce the one or the other. The exciting causes which occasion the first, including wounds, the presence of worms, and other sources of irritation, much more frequently give rise to the second. To what are we to attribute the different result? No answer can be given to this question: it is evidently better therefore to abstain from hypothesis, acknowledge our ignorance of the subject, and recommend it as a subject of experimental investigation.

Diagnosis. Tetanus is readily distinguished from other maladies, by the continued muscular rigidity often suddenly increasing, the distortion of the countenance, and the peculiar pain at the scrobiculus cordis. It has been sometimes closely simulated by hysteria; but the latter disorder is general in females, while tetanus as has been shown, is most common in males. In hysteria also the globus hystericus, the absence of distortion of the face, and the dissimilar exciting causes, are sufficient to indicate the disease. We have stated that sometimes in tetanus there is difficulty of swallowing and horror of liquids. Hydrophobia, however, may be distinguished from these cases by the absence of continued rigidity, and the nature of the spasms which are clonic and of short duration. In general also there is great excitement, and a peculiar anxious expression of countenance very different from the distortion in tetanus. It is scarcely possible to confound this disease with any other.

It is of great importance to discriminate whether tetanus arises spontaneously, or is the effect of poisons containing strychnia. This, however, is very difficult, as the symptoms are identically the same. If the poison be taken internally, there may be signs of unusual irritation in the digestive organs. The sudden occurrence of the disease in its acute form, when the individual has not received any wound, or been exposed to cold and moisture or sudden changes of temperature, are circumstances that should excite suspicion, the truth of which can only be confirmed, during the life of the patient, by strong collateral evidence. Care should be taken to distinguish the trismus arising from local causes, as inflammatory affections about the face and throat, tumours at the base of the jaw, rheumatism of the temporal and masseter muscles, or the local inflammation arising from the administration of mercury.

Prognosis. The prognosis is more unfavourable in the traumatic than in the idiopathic form of tetanus. The danger must also depend on the violence and frequency of the spasms, and the extent to which the muscular system is affected. The great fatality of traumatic tetanus is spoken of by all who have had extensive opportunities of witnessing the disease. Sir J. Macgregor, who saw several hundred cases in the campaigns of Spain and Portugal, witnessed very few recoveries, and Dr. O'Beirne did not see a single recovery out of 200 cases which came under his observation. Hennen, Dickson, Morgan, and others also allude to the uniform fatality of the disease in its acute traumatic form. Several instances of cure however have been recorded. Sir G. Blanc mentions that of twenty cases which occurred in the West Indies, after the action of April, 1782, three recovered. Of thirteen cases witnessed by Mr. Dickinson, surgeon at Grenada, four were cured, and many other instances are recorded by various authors.

The idiopathic form is not so dangerous as the acute, but the recoveries bear no proportion to the deaths. The trismus nascentium of infants is uniformly fatal.

The favourable circumstances are, a long interval between the occurrence of the exciting cause and the accession of the disorder; the slow progress of the disease, and the patient surviving beyond the fourth day; the muscular spasms not being general, frequent, or severe; the respiration easy, and the pulse natural.

The unfavourable symptoms are, quick accession; general spasms and rigidity;

rapid progress of the affection; violent paroxysms occurring frequently; urgent dyspnœa; rapid, thready, and imperceptible pulse; inability to swallow; cold and clammy perspiration; livid countenance; delirium, &c.

Treatment. When our ignorance of the pathology of tetanus is taken into consideration, we need not feel surprised that the treatment has in the generality of cases been strictly empirical. Neither need we wonder that, while the most opposite remedies have been occasionally employed with apparent success, they have each in turn been rejected as unworthy of confidence. Not unfrequently several plans of treatment even opposed to each other have been employed in the same case, and such frequent changes made, that should the patient recover, it is impossible to determine which remedy has produced the beneficial result.

1. *Treatment of idiopathic tetanus.* In idiopathic tetanus attention should be paid to the constitution of the individual, and especially to the state of the vascular system, in order that the principles of treatment may be duly regulated.

As a general rule, if the pulse is full and hard, the system plethoric, the tongue foul and dry, the individual of a strong constitution, the skin hot, or other symptoms indicate increased vascular excitement, general or local blood-letting, or if the symptoms be urgent, both general and local bleeding should be employed. This treatment is evidently indicated if there be pain in the back, or other symptoms of inflammation in the spinal cord or its membranes. At the same time acute purgatives should be administered in order to remove all sources of irritation from the alimentary canal, and repeated if necessary, so as to procure copious evacuations. These means will generally lessen the force of the spasms when tetanus is connected with increased vascular action, which is not uncommon in the idiopathic tetanus. If the spasms continue after these measures have been adopted, sedatives in full doses should be administered. The cold affusion or the cold bath has sometimes been beneficial. If, notwithstanding these means diligently employed and a restricted diet, the symptoms continue, and the disease become chronic, occasional cupping and counter-irritants on the spine should be employed; in short, a treatment adopted somewhat similar to that recommended for chronic spinal meningitis.

If, however, at the commencement of the disease, the patient be feeble and of a weak constitution, or spare habit, with a quick and small pulse, pallid face, and evidence of diminished vascular action, a tonic and stimulating plan of treatment should be had recourse to, combined with sedatives, if the spasms be severe; a generous diet should be allowed, the bowels kept regular if necessary by purgatives with aromatics, and other remedies of a stimulating and tonic kind employed.

When the symptoms assume the form of trismus, a wedge of soft wood should be placed between the teeth, in order to prevent perfect closure of the jaws, and during the progress of the disease every kind of irritation that may occasion an increase or return of the spasms should be carefully guarded against. By adopting a method of treatment on the general principles laid down, we consider that the practitioner will best guard himself against the charge of empiricism, and by steadily pursuing it, will at the same time be most likely to overcome this formidable disease.

2. *Treatment of symptomatic Tetanus.* When we reflect on the numerous trivial injuries which the body may occasionally receive, and to which perhaps the attention is not drawn until the accession of the tetanic symptoms; when moreover the numerous sources of irritation that may exist in other organs, and more especially in the alimentary canal, are considered, it seems very propable that many cases which have been reported as idiopathic are only symptomatic of some disorder which has been entirely overlooked. Mr. Mitchell (*Med. Chir. Trans.*, vol. v., p. 25.) relates a case in which tetanic spasms of the tongue and muscles of the face were removed by abstracting some carious teeth, and he alludes to a similar instance, which occurred under the care of Dr. Thomas. We saw under the care of Dr. Graham, in the Royal Infirmary of Edinburgh, a man affected with opistho-

tonos of an epileptic form, there being loss of consciousness during the paroxysm. In the fit the whole body was powerfully drawn backwards, perfectly rigid, and formed an arch which rested only on the head and heels. Dr. Graham discovered that the dens sapientiæ on one side had not room enough to descend. The next tooth was extracted, and the spasms for a time entirely disappeared. We have since heard that the attacks returned, but that after undergoing a variety of treatment he recovered. Aware, therefore, that the disease may not only be occasioned, but in certain instances kept up, or rendered more severe by local irritation, the utmost pains should be taken to discover its source, and every effort employed, not only to obviate its effects, but remove its cause. If the suppression of the lochia, leucorrhœa, or other chronic discharges have preceded the attack, we should endeavour to promote their return, or establish some artificial drain in the neighbourhood, while any disposition to plethora or increased vascular action should be combated by local or general blood-letting. If there are any symptoms of worms, acute vermifuge remedies should be given both by the mouth and in clyster. A case of powerful trismus, with spasms of the face and abdominal muscles, is related by Dr. E. Phillips, which was relieved immediately by an injection of half an ounce of turpentine with yolk of egg. The following morning there was a copious stool, in which a worm was discovered, and the patient got well. (*Med. Chir. Trans.*, vol. vi. p. 65.) If the disease can be traced to checked perspiration, diaphoretics are indicated.

Wounds, however, are the most frequent cause of symptomatic tetanus, and should in all cases be carefully examined, with the object of ascertaining whether there be any foreign body, in order that it may be at once removed. Whenever the symptoms appear a short time after the reception of a wound, and there can be no doubt that the wound is the exciting cause of the disease, all nervous communication between it and the spinal marrow should be cut off as soon as possible. It is a singular fact, that this practice, which our knowledge of pathology and physiology shows to be necessary, and likely to be successful, has only (as far as medical records go) been performed four or five times, but in all these with perfect success. In a case related by Dr. Murray (*Trans. of Med. and Phys. Soc. of Calcutta*) occasioned by a wound in the left foot, the posterior tibial nerve was divided, and although the patient could not articulate distinctly before, from the closure of the jaws, he immediately opened his mouth with an exclamation, and expressed himself as being benefited. He rapidly recovered. Amputation has also been employed with varying success: surgeons, however, generally condemn this severe proceeding, except when the parts are much lacerated. Should the tetanic symptoms be advanced, it is inadmissible; and as the indication for which it is employed can be answered by dividing the nerves going to the injured part, it may appear extraordinary that it has ever been had recourse to. It should also be kept in mind, that the disease having been once called into action, often continues independently of its local origin. While, therefore, our attention is directed to the exciting cause, we must pursue the constitutional treatment on the principles already laid down.

The numerous remedies which have been recommended in the treatment of this disease have tended to produce great perplexity. Much, however, may possibly be attributed to the indiscriminate manner with which our most powerful medicines have been employed, and to the total absence of any principle in their administration. So far from considering our resources as insufficient, we consider they are fully capable of fulfilling all the indications, if used with perseverance and judgment. The sudden and astonishing cures that have been occasionally produced, when by accident a particular therapeutic remedy has been rightly administered, prove that our present want of success is not to be attributed to the inefficiency of the remedies employed, but to our ignorance of those symptoms in the patient which should direct their application. A few remarks, therefore, on the individual remedies that have been resorted to may not be inappropriate.

Blood-letting is indicated in those cases which are attended with increased vascular excitement, and whenever there are evidences of inflammation in the spinal cord or its membranes. Under such circumstances, it generally diminishes the force of the spasms. In a case where the pulse was full and strong, beating 140 in the minute, Mr. Earle repeatedly bled the patient, and there was remission of the spasms after every venesection. Wine and porter, however, were given to him by the friends, and he died. Vascular depletion has been carried to an extreme extent by some practitioners. From fourteen to fifteen pounds of blood were abstracted by M. Pelletier with success in a few days. (*Rév. Méd.*, 1827.) In one case which recovered, M. Lisfranc bled eight times, and applied 792 leeches over the spine. (*Dict. de Méd. et Chir. Prat.*, art. TETANUS.) In a case of severe opisthotonos published by M. Larrey (*Mém. de Méd. et de Chir. Militaire*, tom. xxxiv,) in the acute stage, which lasted twelve days, he bled four times, and applied 120 leeches to the spine with a like result: M. Carron of Lyons has cured four out of five cases by the same means. In such cases as indicate bleeding, when the malady is acute, as often occurs in traumatic tetanus, venesection should be pushed to such an extent as to produce a marked effect on the system, while leeches are applied to the spine. Purgatives, opium, and other remedies, should be afterwards administered; and when all symptoms of increased vascular excitement have disappeared, the collapse is to be obviated by tonics and stimulants.

Purgatives are of great utility in all forms of tetanus, with the view of removing any source of irritation that may exist in the intestines. Drastic purgatives should be avoided, as instead of removing irritation they often induce it. When vascular excitement exists, this class of remedies may be used freely, so as to produce copious evacuations, and thus promote the effect of other antiphlogistic measures. For this purpose the more active purgatives, such as jalap, gamboge, scammony, &c., may be given. When the powers are depressed, croton or castor oil with turpentine or camphor, both by the mouth and by injection, is best adapted. Turpentine is especially beneficial whenever there are worms in the intestines, and as they often prove the source of irritation, without the patient being aware of the cause, an enema, consisting of an ounce of oil of turpentine with a sufficient quantity of gruel, or formed into an emulsion of yolk of egg, should be one of the first remedies employed. The constipation is occasionally very obstinate in tetanus, and purgatives have been given in very large doses, before any evacuation could be procured. Dr. Briggs has recorded an extraordinary case of this kind (*Edin. Med. and Surg. Journ.*, vol. v. p. 141,) in which, in forty-eight hours, the patient took 210 grains of scammony, 89 grains of gamboge, an ounce and four scruples of jalap, two pounds and a half of infusion of senna, and eight grains of calomel, with decided benefit. If the sphincter be spasmodically closed, so as to prevent the free passage of the fæces, an injection of the infusion of tobacco will for a time diminish the contraction, and tend also to relieve the excited state of the nervous system. When constipation is great, the tobacco enema may be tried, as the purgatives given may possibly produce the desired effect during the temporary relaxation induced by the action of the tobacco. At all times purgatives should be among the first remedies exhibited, as very little impression can be made upon the disease, until the bowels are freely opened. The action of other remedies is also favoured by a free state of the alimentary canal, which should be maintained during the whole progress of the disease. It sometimes happens that it is difficult to give medicines by the mouth, from the powerful closure of the jaws. In general, however, one or two drops of croton oil mixed with a little butter can be inserted between the teeth, but if this cannot be effected, we must have recourse to clysters.

Sedatives have been extensively employed in this disease with a view of lessening the irritation and pain that exists.

Opium has been given in enormous doses, without producing its accustomed effects on the system. Mr. Abernethy found 30 drachms of undissolved opium

in the stomach of an individual who died of tetanus; 20 grains of this substance has been given every three hours for several days. According to Bégin, M. Blaise administered in ten days, 4 pounds, 7 oz., and 6 drachms of laudanum, and 6 oz., 4 drachms, and 45 grains of solid opium. Numerous other cases have been recorded where inordinate doses of this drug have been administered. Yet, although our experience of this medicine has been greater than that of any other, it has been so indiscriminately employed, both alone and in combination with other measures, that great uncertainty prevails regarding its value. On the whole it seems to have been more beneficial in idiopathic than in symptomatic tetanus. Its use has been advocated by Larrey, and opposed by Fournier, Pescay, Rush, and Macgregor. Extensive experience, moreover, has shown that it is a remedy in no way to be depended on, while we are unacquainted with any particular indications that should render its use more applicable in one case than in another. There does not appear to be any necessity for administering the extravagantly large doses so often recommended, and when employed, one or two grains should be given every hour, and this quantity doubled in six hours, if no good effect be produced. In the form of laudanum the minute division favours its operation; from one to two drachms may be given every hour, this quantity being also doubled in six hours if necessary. It may also be given in the form of enema, in half an ounce to two ounces of the tincture, or from 10 to 30 grains of solid opium. The preparations of morphia have not yet been extensively tried in this disease, though there is every probability that they will prove of much service as opium, if not greater. M. Lambert has used it successfully in two cases by the endermic method, and M. Carioli has cured a case of traumatic tetanus in this way: the intense sedative action produced by tobacco has led to its administration in tetanus, and its effect seems to be more powerful and decided than that of opium in lessening nervous irritation, diminishing the force of the pulse, producing nausea, perspiration, and sometimes sleep. Dr. O'Beirne administered it in the form of enema, consisting of a scruple of the leaves infused in eight ounces of water, with the effect of at once producing relaxation of the muscles. On discontinuing the remedy, the spasms returned, but on resuming its use, amelioration again took place. From this time the enema was repeated two or three times a-day, sometimes oftener, and continued for eighteen days. The patient completely recovered. (*Dub. Hosp. Rep.*, vol. iii.) Dr. Anderson, in addition to a decoction of the fresh leaves used as an enema, employed it in the form of bath. Of five cases treated in this way, four recovered. (*Med. Chir. Trans. of Edin.*, vols. i. and ii.) Several other cases have been recorded in which its beneficial effects have been well marked in tetanus; and so far as our present experience of it has extended, it appears to be the most efficient remedy of this class. The best form of administration is that of enema, of the strength used by Dr. O'Beirne, which should be repeated sufficiently often to keep the system under its influence. Care must be taken not to increase the dose too suddenly, as such prostration may be occasioned as to prove fatal. At all times a most distressing feeling of sinking and depression is induced. It should be remembered also, that some individuals are more susceptible than others to its effects, and that sailors and persons addicted to its use require a larger dose.

Antimony from its well known depressing effect has been employed in cases where vascular excitement is well marked. Its tendency to occasion vomiting is a powerful objection to its use, an effect which often aggravates the disease, and increases the severity of the spasms. Mr. Liston speaks of a case in which it was successful (*Lancet*, 1834-5.) and another is recorded by Mr. Woodward (*Dub. Journ.*, 1835.)

Hydrocyanic acid has been recommended by Mr. Ward of Gloucester (*Obs. on Tetanus*, 1835,) who gave a drop and a half of it every half hour to a girl labouring under the disease, who ultimately recovered. We have very little experience of this remedy, and its sedative action is by no means so certain or manageable as

that of opium or tobacco. Digitalis, stramonium, belladonna, hyosciamus, and conium, have been tried, and found comparatively inert.

The effects of the cold affusion are very similar to those of tobacco, namely, great prostration and temporary relaxation of the muscles. It has been strongly recommended by Drs. Wright, Currie, and Rush, who thought it a tonic remedy, and several cases have been recorded in which it has been the apparent means of recovery. Three in particular related by Dr. Doue (*Nouv. Bull Med.*, March, 1818,) shows its beneficial action when energetically employed. In other instances, however, it has failed, and in a few has occasioned sudden death. Dr. Elliotson gives an instance, and Mr. Morgan relates another, in which the patient, on being plunged into the cold bath, died immediately. The most powerful effect is produced by pouring several buckets of cold water from a considerable height over the individual, in a continued stream. Syncope is often produced by these means, so that stimulants should be at hand, and the patient after being wiped dry, placed in warm blankets. As he recovers, the stimulants should be discontinued, and, if the spasms return, the cold affusion repeated. A less powerful effect is produced by plunging the patient into the cold bath, or dashing cold water on the body. In the present state of our knowledge cold appears, when properly applied, to be one of the most active and useful agents we possess. It has been most beneficial in the idiopathic forms of the disease.

Tonics and stimulants have been recommended by Drs. Wright, Currie, Rush, Bright, and others; and whenever there are signs of debility, either at the commencement or in the course of the disease, they are directly indicated. Rush gave wine and bark liberally with occasional success. In a remarkable case given by Dr. Currie (*Med. Rep.* vol. i. p. 148,) the patient took 140 bottles of Madeira wine in less than a month, taking generally every twenty-four hours four or five bottles with two gallons of strong broth, some ale and brandy, and two drachms and a half of laudanum. Laudanum and other embrocations with the tepid bath were also used. The recovery was slow. Spirits, wine, and ale, may be given in large quantities without producing their accustomed effects, although Dr. Cross is reported, when other medicines had failed, to have kept the patient for ten days in a state of intoxication with spirits, and, singular to relate, with the result of a perfect recovery. (*Good's Study of Med.*, vol. iii. p. 268.)

Fournier Pescay recommends musk, which he has used with success in doses of 10 or 12 grains every hour. Mr. S. Cooper however states, that 120 grains were given to a young girl in the space of twelve hours without producing any benefit. (*Surg. Dict.*, art. TETANUS.) Fournier Pescay gives some cases which were cured by M. Francois with ammonia. Carbonate of iron has been employed by Dr. Elliotson from an analogy he considers to exist between this disease and hysteria and chorea. (*Med. Chir. Trans.*, vol. xv. p. 161.) Recovery took place in two cases out of three. Dr. Dehayne of Wolverhampton gave a pound daily, and the patient got well. A larger dose than two drachms appears unnecessary, and in acute cases the remedy is inadmissible on account of the time necessary for its effects to be manifested. Quinine has also been given extensively in conjunction with stimulants and tonics. Dr. Bright has published a case that terminated successfully, in which in the course of twenty days the patient took two ounces of the sulphate of quinine, and drank daily from fourteen to twenty ounces of wine, besides taking brandy and ammonia. (*Guy's Hospital Reports*, vol. i. p. 111.) In this as well as in the generality of cases where a tonic and stimulating line of treatment has been pursued, opium was also given, so that it is impossible to know whether the recovery is attributable to any one particular remedy, or to the combined treatment. Preparations of zinc and iron and other tonics have been recommended.

Sudorifics are indicated in chronic cases when the disease arises from any sudden check to the perspiration. The vapour bath has been recommended by Dr. Marsh (*Dub. Hos. Rep.*, vol. iv. p. 567,) who has given two cases which recovered apparently by its use. We have seen a case successfully treated in this way

by M. Sanson at La Pitie, and other instances are recorded. (*Journ. Heb. de Méd.*, 1828.) Its trial has not been very extensive; for as it is necessary to keep the patient in the bath for a long time, its use seems inadmissible in acute cases. The warm bath may be useful in chronic cases, as it relieves the rigidity and uneasiness which is sometimes present. In acute tetanus it is of little service, and instances are recorded where it produced sudden death. It is highly spoken of by Bajon, Chalmers, and Boyer. Fournier Pescay and Stutz used medicated baths containing the deutoxide of potassium and lime, combined with the internal administration of opium. Dr. Latham recommended Dover's powder, which in some cases has also been beneficial. A diaphoretic treatment, with small doses of opium gradually increased, and alkaline baths, have proved successful in the hands of M. Fritz of Prague.

Among the other remedies which have been employed, mercury has been extensively given, although on what principle it is difficult to explain; for although it tends to lessen inflammation, and sometimes acts as a stimulant, we possess better and more powerful remedies for these purposes. Whenever success has attended the use of this mineral, it has been combined with opium or some other remedy, so that it is impossible to speak decidedly as to its effects. Mr. Curling has seen two cases where the ptyalism it occasioned, produced great suffering, and in which the patients were compelled to keep their lips constantly open with their fingers, in order to prevent the suffocating paroxysms consequent upon attempting to swallow the saliva. Camphor, from its combined narcotic and stimulant properties, may be given in some cases with benefit, particularly in the form of enema. Combined with opium it is much praised by Larry. Colchicum has been given with partial success by Drs. Smith and Dufresnoy, combined with opium. Injection into the veins of a watery solution of opium and stramonium has been employed by MM. Percy and Laurent. Dazille recommends ether. Counter-irritants applied to the spine are beneficial in chronic cases. M. Cruveilhier apparently cured a patient in whom the hiccough and spasms were very distressing, by constant pressure on the abdomen. (*Rév. Méd.* Avril, 1824.) Other remedies have been recommended and occasionally tried, such as phosphorus, electricity, strychnine, acupuncture, &c., but we have no proof of their efficacy.

In all cases of tetanus the diet should be light, consisting of soups, gruel, &c. It should be antiphlogistic when there are symptoms of excitement, and nourishing when the vital powers are depressed. It is not always easy to give the patient sufficient nourishment, as sometimes the teeth are so firmly closed, that no substance whatever can be introduced: in other instances all attempts to swallow bring on the most violent spasms. In the former case, liquid food may be introduced into the stomach through a tube passed into the stomach by the nostrils, and in the latter the spasmodic action should be overcome by tobacco injections, and advantage taken of the period of prostration to give food. Articles of nourishment may also be thrown into the intestines by the syringe.

H Y D R O P H O B I A.

Definition of the disease.—Premonitory symptoms.—Symptoms of the attack.—Various modifications observed in the symptoms in the human subject.—Symptoms of rabies in the dog.—Predisposing causes.—Exciting causes.—Nature.—Anatomical characters.—Diagnosis.—Prognosis.—Prophylactic or preventive treatment.—Curative treatment.

THE disease termed hydrophobia from (*υδωρ*, water, and *φοβος*, fear) is characterized by spasms of the muscles of the pharynx and chest; difficulty of drinking, and dread of fluids; great restlessness, and mental inquietude.

From the circumstance that water is not the only substance which causes dread, it has been denominated *hygrophobia* with a view of indicating the inability to swallow any kind of liquid; *phobodipsia*, to express the presence of thirst, with the dread of liquids; *aërophobia*, or dread of air; *pantaphobia*, dread of all things. As these various terms allude to a symptom which is only occasionally present, they are in no respect preferable to that of hydrophobia. Some modern authors have called it *rabies*, *rabies canina*, or *rage*; but these denominations imply delirium, or a furious state of mind, which is rarely observed, and the word *canina* is evidently useless, as the malady is occasioned not only by the bites of dogs, but of cats, wolves, and other animals. The disease is called *lyssa* in the nosology of Dr. Good, from *λυσσα*, a word used by the Greeks to express madness in dogs; but rabies in these animals differs from hydrophobia in the human subject. The French have endeavoured to establish two diseases, according as the symptoms are produced by the bite of a rabid animal, or by other causes. The former they call *la rage*, and the latter *hydrophobie*. But the symptoms and treatment in both are identical, and, as far as our present knowledge extends, their nature is the same. We do not therefore consider that any of the terms which have been proposed are at all preferable to that of hydrophobia, although undoubtedly it is not free from objection; but there is scarcely a disorder which does not undergo modifications in different individuals; and, as Dr. Bardsley has stated, “few rational physicians expect to find the history of a disease condensed into a sort of essence in its name.” As moreover, notwithstanding the various alterations which have been proposed, the term hydrophobia has been generally employed for a series of ages, and is still almost universally adopted, we shall retain it to express the group of symptoms above detailed, from whatever cause they proceed, as well as when the disease undoubtedly arises from the bite of a rabid animal.

Symptoms. Some authors have divided the disease into periods or stages, denoted by the appearance of certain symptoms. As such divisions, however, are purely arbitrary, and lead to no practical utility, we shall describe, 1. The premonitory symptoms; and, 2. Those which constitute the attack.

1. When the disease, as is generally the case, arises from the bite of a rabid animal, the most marked premonitory symptom is pain in or round the bitten part, which often resembles that caused by rheumatism, and sometimes attended with itching. The nature of the pain is liable to variations, being more or less

acute; sometimes there is a feeling of torpor, stiffness, tingling, heat or coldness, which does not amount to actual suffering. The pain extends gradually along the course of the nerves, and if the hand be the part bitten, shoots to the forearm, arm, or shoulder, and sometimes to the muscles of the neck; or, if the injury be in the leg, to the thigh, hip, or loins. In some cases, the pain does not arise in the wound, but in a part near the trunk, as the shoulder or hip; the cicatrix swells, inflames, becomes red or livid, and occasionally, after it has cicatrized, opens, discharging an ichorous matter. Sometimes the pain shoots from the wound to the region of the heart, and now and then darting pains are felt in various parts of the body. Callisen (*Syst. Chir. Hodiern*, vol. i. p. 595,) Marcet, and Babington, have observed that these pains follow the course of the nerves, and never irritate or produce inflammation in the absorbent glands or vessels. The local symptoms detailed are often accompanied by desire of solitude, unwillingness to answer questions, dull despair, and other signs of mental depression; but more generally the intellectual faculties are not at all altered; not unfrequently, indeed, the imagination is more fertile, the memory stronger, the patient's conversation animated, both the mental and bodily powers displaying unusual activity. In some cases, on the other hand, there is intolerance of light, with dilatation of the pupil, contracted eyebrows, and tumid face; or wandering pains in the neck, trunk, or limbs; pain, or a sense of heaviness in the head; restlessness, drowsiness, and disturbed sleep; occasionally sighing, momentary flushes and rigours, slight febrile symptoms, loathing of food, loss of appetite, nausea, vomiting, constipation, pains in the abdomen, &c.

These premonitory symptoms are not peculiar to hydrophobia; but when one or more occur after an individual has been bitten by a dog, there is just cause for alarm. The symptoms do not follow any order which can indicate an approaching attack of hydrophobia; pain in the wounded part being felt by one patient, melancholy by another, or intolerance of light by a third; on the other hand, every one of these have been absent in certain cases.

The duration of the premonitory symptoms is, in general, from four to six days; cases, however, have occurred, in which they existed two or three days only.

2. *Symptoms of the disease.* Hydrophobia may be considered established when there is a peculiar constriction about the throat, which, at the commencement, is usually slight. It frequently resembles a feeling of stiffness, gradually extending towards the root of the tongue and thyroid cartilage, and is often accompanied with pain. The patient experiences difficulty of swallowing, especially fluids; and all endeavours to accomplish this are apparently prevented by sobbing, or deep catching sighs. At the same time the liquid contained in any vessel held in the hand, is generally either spilt on the ground or violently jerked to a distance. These symptoms are usually of short duration, but often leave in the mind of the patient a continual dread of water or other fluids, so that even the idea of drinking induces their return. Deglutition gradually becomes more and more difficult, until at length, any attempt to swallow, particularly liquids, produces violent spasm of the muscles of the pharynx and larynx, and occasionally of those of the face, the patient, being, at the same time, thrown into a state of the greatest agitation and alarm. The horror of fluids is often such that any circumstance which can lead to the idea of drinking, as the splashing or running of water, the sight of jugs or glasses, the rattling of earthen-ware, the noise of a pump, or even the mention of any kind of beverage, is often sufficient to occasion a recurrence of the spasms. As the disease advances, the irritability becomes greater, the spasms are more frequent and prolonged, and though generally confined to a limited number of muscles, occasionally the whole muscular system is affected, and such is the morbid sensibility, that the spasms may be excited by various trifling causes, as a current of air, opening a door or window, a strong light, looking at a polished surface, &c.

In the interval of the paroxysms, there is an unusual degree of debility. As

the spasms increase in frequency, the respiration becomes more uneasy, and often interrupted by occasional deep inspirations or sighs; some individuals scream loudly from slight causes. To these succeed flatulent eructations, often vomiting, urgent thirst, sense of obstruction in the throat, increased secretion of saliva, intense headach, and acute pain, either in the epigastrium or throughout the whole course of the spine, particularly in the cervical portion. The state of the patient is now very distressing; the countenance expresses the utmost anxiety and alarm; the eyebrows are contracted; the eyes staring and glassy, giving a peculiar wild expression; there is intolerance of light, and of sounds; the speech is abrupt and rapid; the angles of the mouth are drawn slightly upwards, giving the countenance an expression somewhat approaching the risus sardonicus; the face is sometimes pale, often flushed or covered with large irregular ruddy spots; the saliva is secreted abundantly, and ejected repeatedly and with considerable force; the heat of the skin is in general natural, but occasionally increased; the pulse is quick, and of variable strength; and the respiration, although in some cases not much affected, is usually hurried and laborious. In the midst of so much suffering, the intelligence remains perfect, and the patient retains his consciousness. These aggravated symptoms may be established a few hours after the commencement of the disease, but in general are not fully developed before the second day. The disorder now progresses rapidly; the patient experiences a burning heat and dryness in the throat; and the attempts to relieve this by drinks produce severe convulsions of the whole body, in which the patient appears on the point of suffocation. The spasms appear to come on spontaneously, or to be produced by the most trivial causes, as touching the surface, or the hairs of the head; the saliva becomes thick, viscid, and adhesive; it accumulates about the glottis, increasing the irritation in the throat; and, in the efforts the patient makes to remove it, rapid reiterated noises are produced, which have been supposed by the vulgar to resemble the bark of a dog. The voice is hoarse; the feeling of thirst, and sometimes of hunger, the pain in the stomach and tension of the præcordia, become more urgent, and the eructations more frequent; vomiting of a yellow, greenish, glairy, or grumous fluid succeeds, the abdomen being, at the same time, distended, or sometimes retracted and drawn towards the spine. As the fatal issue approaches, there is general and incessant tremor; the convulsions are increased in frequency and violence; the sense of suffocation is more urgent; and from the difficulty of expelling the saliva, it collects in the mouth, and flows over the lips; the pulse becomes small, irregular, feeble, and rapid; the patient evinces great terror, or lapses into a state of wild delirium; hiccough and rapid breathing succeed, followed by gradual exhaustion; and at length the patient dies in an intense paroxysm. Sometimes a temporary calm takes place before death, which, however, is only the precursor to a fatal return of the spasms; occasionally, the unfortunate sufferer expires in perfect tranquillity.

The duration of the hydrophobic symptoms is in general from two to three days; but cases are recorded in which they have been prolonged to eight or nine days. The disease has also been known to be fatal in thirty-six hours.

Such is the general progress of this dreadful disease; but almost every one of the above symptoms occasionally undergo modifications. The dread of water and liquids has always been considered the most remarkable symptom of the disorder, and apparently arises from a conviction the patient entertains, that every attempt to swallow will produce the greatest suffering. Though there is difficulty in swallowing any thing, it has been observed that the deglutition of solids does not occasion such distress as that of liquids—a circumstance which has been attributed to the greater surface of the pharynx, with which the latter, in the act of deglutition, are brought into contact. Some individuals have resolutely determined to swallow water, and have only been prevented by the violent pharyngeal spasms which the contact of the liquid occasioned; others, who have retained an insuperable aversion to water, have been able to drink easily red wine, or broth. M. Cayol attended a young girl labouring under this disease, who had no great

dread of liquids, though she disliked them, and was not absolutely unable to swallow them, notwithstanding there was great difficulty in the effort. Dr. Bright and others have recorded cases in which there was no abhorrence of fluids, but only a disinclination to swallow, or to allow any thing to approach the mouth. In the course of the disease, this symptom undergoes remissions, not unfrequently before death. Occasionally, also, there is complete intermission, during which the patient drinks with tolerable comfort.

The mental faculties are generally observed to be altered, but in what the alteration consists it is often difficult to determine. The consciousness and reasoning powers usually remain perfect in the midst of the most dreadful sufferings; but there is evidently mental excitement, manifested by increased loquacity, and circumstantial explanations, unusual and uncalled for on the part of the individual. There is often great tendency to take alarm from trivial causes, to form suspicions without adequate motives, and an extraordinary susceptibility to circumstances associated with the idea of drinking. These symptoms are liable to various alterations in different individuals; in some cases they have been altogether absent, the mind having been little disturbed from the commencement to the termination of the disease. Furious delirium is rarely present, and then only during violent paroxysms or towards the close of the disease. But there is often, even soon after the commencement of the symptoms, muttering, unconnected talking, and hallucinations of mind, although, when spoken to, the patient gives rational answers. The mental faculties also evidently exercise considerable influence over the other symptoms, which have been observed to be more or less distressing and urgent, according to the weakness or strength of the patient's intellect.

The sensibility, both general and special, may be greatly increased. There is always great pain in the throat, sometimes in the thyroid gland, and occasionally in the neck and spinal column. This increases as the spasms become more violent; and when the symptoms are intense, there is usually excruciating pain in the chest and epigastrium. Though in most instances patients betray great dread of being touched, and regard with aversion the approach of individuals, particularly strangers, the sense to touch remains unaltered: sometimes a sense of tickling is produced by contact. In other instances the sense of touch is very acute, and great uneasiness is often occasioned by the contact of the lightest body, or by currents of cold or heated air. In a case described by Magendie, touching the hair induced a recurrence of the spasms; and in another by Dr. Powell, the same effect was produced by a fly settling on the face. It has been noticed that the sensibility to light is also morbidly increased; hence daylight, burning objects, brilliant colours, and polished surfaces, often produce great distress and a return of the paroxysms. The hearing is also very acute, and noises that cannot be distinguished by others, are occasionally complained of. A patient treated by Magendie heard distinctly, during the paroxysms, though born deaf and dumb. Disagreeable odours also are sometimes perceived, which are inappreciable to others. It almost always happens, however, that, towards the end of the disease, the different senses become more or less obtuse, and even entirely lost.

The muscular system is variously affected. The disease essentially consists in a spasm of the pharyngeal or laryngeal muscles, of greater or less intensity, occasioning the difficulty of deglutition, particularly of liquids, which forms the prominent symptom of the disorder. Occasionally the spasms appear to commence by rigidity and stiffness at the root of the tongue. Inspection of the throat in some cases detects turgescence and other signs of inflammation about the fauces, but in others nothing morbid can be seen. In the intervals there is not unfrequently unnatural activity, and occasionally a desire to perform certain motions, as leaping upwards, running backwards, climbing, &c. Towards the termination of the disease, the hands and legs are thrown about convulsively, and sometimes the spasms resemble those of tetanus, the trunk being drawn backwards. In a case given by Dr. J. Johnson, the sphincter ani was so firmly constricted by spasm, that powerful efforts to pass a clyster-pipe failed. In some cases the spasms are accompanied

by priapism, contraction of the cremasters, and involuntary seminal emissions; in others, towards the termination, paraplegia, hemiplegia, or general paralysis, supervene. The *pulse* is generally accelerated, but of variable strength. At a late period it becomes quick (sometimes 150 in the minute,) weak, wiry, and irregular.

The respiration is differently affected in various stages of the disease. At the commencement the breathing is convulsive, or the patient sighs deeply; or there are sobs, occasioned by efforts to swallow, or by terror. As the paroxysms become more intense, the respiration is difficult and laborious, so that suffocation is often threatened. During the remissions the breathing becomes more easy, but sometimes interrupted by frequent sighs and sobs every fourth or fifth inspiration. The skin is not unfrequently covered with a profuse perspiration, but sometimes it is hot and dry, occasionally harsh, while the heat is not increased; in one or two cases it has been observed livid. The excretions are not particularly affected; occasionally there is great constipation. In general there is no alteration in the urine; in some few cases it has been observed to be scanty, and of a pale greenish or lemon colour; in others high-coloured. Towards the termination of the disorder, both fæces and urine are often passed involuntarily.

The mouth is usually filled with saliva, which at first frothy, becomes gradually so thick and tenacious as to adhere to the lips. The tongue is sometimes moist, and more or less furred. Nausea is a frequent symptom, and in the fatal forms of the disease there is not unfrequently vomiting of a yellow, greenish, glairy or grumous fluid, resembling coffee-grounds.

Symptoms of rabies in the dog. As every practitioner, particularly in the country, is liable occasionally to be called on to determine whether a dog is rabid, we shall give the principal symptoms of rabies in this animal, referring to works of veterinary medicine for more ample details, and especially to the treatise of Mr. Youatt on this subject. It is necessary at the commencement to remove from the mind an idea which is very general, viz: that the disease in quadrupeds is similar to hydrophobia in man. Many persons suppose that, as the animal does not evince any dread of water, or appear wild and furious, it is not in a rabid state, and have consequently been lulled into dangerous security. The first symptom observed in the dog is a change in his usual habits; in some there is a disposition to pick up straws, rags, bits of paper, or any small objects; in others, licking cold surfaces, as iron, stones, &c., or different parts of other dogs that may be domesticated with him. Sometimes the dog becomes attached to animals formerly regarded with indifference, but more generally an antipathy to strange dogs and cats is early observed, particularly to cats. It becomes lonely and irritable; is less eager for food, or neglects it, but is evidently thirsty: there is sometimes redness and watering of the eyes; the ears and tail droop, and his look is suspicious and haggard. In a short time the respiration becomes difficult; sometimes there is vomiting, and saliva flows from the mouth, which soon assumes the form of viscid foam. The rabid dog now shows great irritability, with disposition to bite other animals, but is still obedient to the voice of its master; and though seldom, unless enraged, attacking the human subject, occasionally flies at every creature it meets. Holding up a stick or whip invariably excites great fury, and never intimidates. In the advanced stages of the malady, the breathing becomes more laborious, and death takes place during strong convulsions.

In the lower animals there is no dread of water; the dog, although unable to swallow, flies to it with eagerness; and all other quadrupeds in the rabid state, with perhaps an occasional exception in the horse, drink with ease and with increased avidity. (*Youatt.*) In most instances, also, there is not the savage fury which persons in general expect to find, but rather a snappish irritability. In many instances, however, the most furiously rabid animals are obedient to the master's control.

Causes. Whether there be any particular *predisposing* causes of hydrophobia is at present a matter of great doubt, inasmuch as it has attacked individuals of both sexes, at all ages, and in all seasons and climates. Neither has any particu-

lar constitution, habit of body diet, or other circumstances, been found incompatible with the manifestation of the disease. It has undoubtedly been more common in some countries than in others, and in these countries more frequent at particular periods. The lower classes also have been more frequently affected. These circumstances, however, do not appear to be connected with any inherent predisposition in the human frame, but are owing to accidental occurrences, such as the greater prevalence of rabies among dogs, or other animals, in particular countries, and at different seasons, while the labouring classes are necessarily more exposed. In the absence of positive knowledge on this subject, therefore, we do not consider ourselves warranted in entering into a consideration of what some have considered predisposing causes of hydrophobia.

Of the *exciting* causes the introduction into the system of the saliva of rabid animals is by far the most frequent. Though it has been generally thought that the hydrophobic poison can be introduced only by the medium of a wound inflicted by the bite of a rabid animal, yet, according to Portal, Matthieu, Gillman, and others, the disease may be developed when the mucous membrane has been exposed to the action of the virus. That inoculation is necessary to the production of hydrophobia, is established by the following facts: 1. The same phenomena having been known to follow the bite of dogs from the earliest ages. 2. The similarity of the symptoms in different persons who have been bitten by the same rabid animal. 3. The more frequent occurrence of the disease in those who have received the bite on uncovered parts, as the hands and face; and, 4. By experimental proofs that the introduction of the saliva of a rabid animal into the system of a healthy quadruped will produce the same disease. Magendie and Breschet induced rabies in the dog by inoculating the animal with the saliva of a hydrophobic man. We consider it unnecessary to allude to particular examples, with a view of proving the above statements. That the bite of a mad dog will occasion hydrophobia has been universally believed for a series of ages—a belief that the careful observations and scientific researches of modern times have tended to confirm.

We consider it, however, incontestibly proved, that other causes are capable of producing hydrophobia, attended with symptoms exactly resembling those occasioned by the bite of a rabid animal. Pinel relates the case of a young soldier who, disliking the military profession, secluded himself. His comrades, attributing this to cowardice, entered at midnight into his chamber, beating the charge on the drum, and crying that the Austrians had passed the Rhine. He was immediately seized with convulsions, accompanied with a sensation of burning and constriction in the throat, dread of liquids, and expectoration of a copious frothy saliva. In the morning the horror of fluids and burning pain in the throat were more intense, accompanied with a sense of weight in the head, hurried and irregular respiration, intermittent feeble pulse, and intolerance of light, but without alteration in the intellectual functions. He was certain that he had never been bitten by any animal. The symptoms increased, and he died. The examination presented nothing extraordinary. A quantity of mucus only was found in the throat. (Pinel, *Nosog. Phil.*, tom. iii. p. 145, 4th edit.) The minute details of this case, corresponding with the principal symptoms described as constituting hydrophobia, were identical with those of hydrophobia arising from inoculation. In Hufeland's *Journal* (December, 1839) there is a similar case from the bite of a dog received five weeks before the symptoms appeared. The dog was perfectly healthy, and remained so after the individual bitten had died labouring under the most dreadful form of hydrophobia. A well-reported case, occasioned by great fatigue during a hot day, is also recorded, in which all the symptoms of hydrophobia were well marked: it terminated fatally. (*Journ. des Savans*, Août, 1757, p. 81.) In others, horror of water, and symptoms resembling hydrophobia, have followed rheumatic and inflammatory affections, exanthematous fevers, cerebral lesions, suppression of habitual discharges, some kinds of poisons, &c. (*Dict. des Sciences Méd.*, art. HYDROPHOBIE.) Many of these cases no doubt are

not sufficiently well detailed to demonstrate satisfactorily that the disease was in every respect identical with hydrophobia; but a sufficient number exist to prove that it has not unfrequently occurred independently of hysteric, epileptic, or tetanic complication. It may then be considered perfectly established, that hydrophobia is the result of a peculiar poison with which the system may be inoculated, but that it may also be occasioned by other causes, especially powerful mental impressions.

These facts have led to much dispute; some thinking that the state of the mind induces the disease, because the symptoms come on some time after the local injury, and are preceded by evident signs of mental disturbance. Others affirm that it can only be produced by the hydrophobic virus, and that the supposed terror may have originated in some bite which had been forgotten. A third class adopt neither of these views, but consider one cause or the other as producing distinct diseases; the one they denominate hydrophobia, and the other "La rage." That inoculation alone is sufficient to produce the disorder, is proved by its having been thus occasioned in infants, horses, asses, &c., in which the force of imagination cannot be supposed to operate. Five cases also are reported by Mr. Hewitt to have occurred in natives of the East Indies who were bitten by a jackal, and who had never heard of the disease, or had even a suspicion of its nature. (*Med. Chir. Trans.*, vol. xiii.) On the other hand there is every reason to suppose, that the disease may occur solely from mental disturbance, or the other causes to which we have alluded. We see no reason, therefore, for adopting any exclusive view of the origin of hydrophobia, or for considering diseases distinct because their exciting causes are different. Many fevers and eruptive disorders may arise spontaneously, or be the result of contagion. Tetanus, it is known, may be produced by exposure to cold, or it may succeed to wounds, or the introduction of poisons, such as strychnine for example. In like manner paralysis may be occasioned by a poison, (lead,) as well as by mental emotions or other causes. Epilepsy, and numerous other diseases, may arise from causes widely different, and yet, as far as our means of observation extend, the disease occasioned is identically the same. Such we consider to be the case with hydrophobia. It has been remarked with regard to tetanus and other affections, that the influence of a wound combined with that of exposure to cold and bad weather, or terror, has a greater effect in the production of the disorder than when one of these causes act alone. The same is the case with hydrophobia; the bite of a rabid animal is more liable to produce the malady in individuals who are impressed with a horror and dread of its effects, than in those who do not experience any imaginary fears. We have observed that in some years, when the public prints industriously circulate an account of the dreadful symptoms of hydrophobia, and the means necessary to guard against their appearance, cases soon become very frequent; and, although this may undoubtedly be attributed to other causes, it is not improbable that the moral effects thus produced may favour the production of the disease.

The accession of the symptoms may take place at different periods after the reception of the bite. Mr. S. Cooper states, that of 131 cases none of the patients became ill before the eleventh day after the bite, and only 3 before the eighteenth. Of 15 cases mentioned by Troillet, 7 were attacked between the fourteenth and thirtieth days; 5 between the thirtieth and fortieth days; 2 a little after that period; and one after fourteen weeks. (*Obs. Chir. sur la Rage.*) The most general period is between the twentieth and fortieth days, but cases are mentioned by Marestan, Astruc, Willoughby, and others, in which it occurred two, three, and six days after the bite. On the other hand, numerous instances are recorded in which several months have elapsed. Dr. J. Vaughan mentions an interval of nine months; Mead of eleven months; and Bauheir and Boissière of a year; Brown and Adams fifteen months (*Trans. Med. and Phys. Soc. of Calcutta*;) Nourse of nineteen months; R. Lentilius of three years (*Cooper's Dict.*, art. HYDROPHOBIA;) and Lusitanus, four years. (*De Prax. Admir.*, lib. iii. obs. 87.) Dr. S. Bardsley gives a case that occurred twelve years after a bite

had been received (*Manchester Memoirs*, vol. iv.;) and others are recorded where it is said to have appeared after an interval of eighteen, twenty, and even thirty years. (*Dict. des Sciences Méd.*, art. RAGE.) We cannot however suppose, that in any of these latter cases the bite was the exciting cause of the disease, though it is difficult to determine what is the latest period at which the virus may be supposed capable of producing the disorder. Dr. J. Hunter considers seventeen months, and Dr. Hamilton nineteen months, as the longest possible interval. (*On Hydrop.*, vol. i. p. 115.) Dr. J. L. Bardsley thinks two years constitute the limit. (*Cyc. of Pract. Med.*, art. HYDROPHOBIA.) We may observe, however, that even these periods appear to be very long for a poison to lurk in the system without producing any effect; and knowing that mental disturbance is capable of producing the disease, there must always be great doubts whether or not such cases were produced by the former or the latter cause. When hydrophobia is occasioned by mental impressions, the interval is not so long. The premonitory symptoms commence at once, and last from one to five days, and occasionally the disease is declared immediately. This is the only important distinction between spontaneous hydrophobia and that occurring from inoculation; but no nosologist would be warranted in founding a distinction on a circumstance, which in all diseases, and in this, more especially, is so uncertain.

Anatomical characters. In this, as in other diseases of the nervous system, no uniform appearances have been presented after death.

The brain has, in several instances, presented signs of congestion. The sinuses and vessels of the membranes have been observed considerably injected, and more or less effusion of serum found in the ventricles, and in the arachnoid and sub-arachnoid cavities. These appearances were found in six cases dissected by Troiliet (*Sur la Rage*), who also observed the surface of the cerebrum studded with scarlet points, and the plexus choroides of a brown colour, and gorged with blood. In two cases, blood was extravasated towards the base of the brain in large quantity; and in others there existed a plexus of vessels somewhat injected, surrounding the origin of the optic and pneumo-gastric nerves. In five cases inspected by Dr. J. L. Bardsley (*Cyc. of Pract. Med.*), three presented traces of considerable cerebral vascularity; in the fourth there was only slight turgescence of the vessels of the pia mater, and rather more distention than usual of the choroid plexus; in the fifth the brain was natural. Dr. Marshall and other writers have also shown the frequent existence of congestion within the cranium. In some cases the substance of the organ has been found somewhat softened, and in one or two instances rather indurated. Bony depositions have been occasionally met with in different parts of the dura mater and arachnoid. On the other hand, Van Swieten, Bonetus, Lieutaud, and others, have seen cases where, after death, no alteration could be detected in the brain.

The spinal cord has often been found to exhibit signs of congestion. Instances of this kind have been reported by Salin, Brera, Saunders, Reid, Troiliet, Ribes Ollivier, Goodrich, and others. Dr. A. T. Thomson has recorded a case in which the spinal cord was covered with blood, and its vessels turgid. (*Med. Chir. Trans.*, vol. xiii.) M. Mathey found a quantity of serum within the spinal canal. (*Journ. Gén. de Méd.*, tom. liv. p. 279.) In a case by M. Clot, cited by Ollivier, the cellular tissue which surrounded the cervical portion of the cord was very red, and infiltrated with a large quantity of blood. Its substance also, at this part, was intensely inflamed, contrasting strongly with the whiteness of the dorsal and lumbar portions. Ollivier has found softening in the inferior portion of the dorsal region in an individual who died of the disease. In a case by Dr. Bright also (*Hosp. Rep.*, case 285,) the whole substance of the cord was found softened for a quarter of an inch in the same situation. A case is given in Johnson's *Med. Chir. Rev.*, 1817, in which the principle marks of disease were in the coverings of the pons varolii, medulla oblongata, and upper part of the spinal cord. These parts formed one crust of inflammation, most intense on the spinal cord. Similar

lesions have been found in the lower animals by Dupuy and Barthelemy. Dr. Bright tells us, that in one case examined at St. Thomas's Hospital, small plates of bone were found in the arachnoid of the spinal cord. In several instances, however, no morbid appearances whatever could be detected in the spinal marrow. M. Gendrin, in particular, says he has examined many cases of hydrophobia, and never could discover any disease in the spinal cord or nervous ganglia. (*Transl. of Abercrombie on the Brain*, p. 578.)

The pharynx and œsophagus, to which the most prominent symptoms of the disorder are referred, have often been found diseased. Sauvages, Rossi, Rush, Gorci, Ribes, Bardsley, and others, have found marks of inflammation in one or other of these situations, and sometimes in both. Dr. Powell found the œsophagus covered by a thin layer of coagulable lymph, an appearance also seen by Oldknow, Ballingall, and Ferrier. Dr. J. L. Bardsley in one case discovered in the œsophagus a membrane lying closely within the orifice without filling up the cavity. When inflated by the blow-pipe, it assumed a tubular appearance. He considered it a portion of the internal membrane of the œsophagus. In other cases, however, no morbid change could be discovered in these parts, or they were only covered by a frothy mucus. In the six cases dissected by Troiliet the mouth and fauces were of a pale grayish colour, and so signs of inflammation existed in the pharynx.

The lungs have often been found somewhat engorged with blood, and of a deep red colour. This occurred in all the six cases examined by Troiliet, as well as in those observed by Morgagni, Portal, Oldknow, Ballingall, Marshall, and numerous other writers. The larynx, trachea, and bronchia, have presented traces of inflammation, and been found lined with a thick, white, frothy mucus by Faure, Troiliet, Rush, Ribes, Lalouette, and others. The extent and intensity of this inflammation appear from the dissections that have been made to be proportionate to the violence of the dyspnœa.

In two cases by Troiliet, gelatinous clots were found in the heart and large vessels, but the greater portion of the blood was black and fluid, as in subjects who have died of asphyxia.

The mucous membrane of the stomach and small intestines have been found more or less inflamed by Morgagni, Powell, Oldknow, Ballingall, and others. Dupuytren found the former almost gangrenous. The salivary glands have occasionally been found enlarged and very vascular. Numerous alterations and displacements of the other viscera have been reported by different authors, which we have reason to believe were accidental.

It should also be understood, that some individuals have died of hydrophobia, in whom no alterations whatever, either in the nervous, circulatory, respiratory, or digestive symptoms, have been found. (*Vaughan, Fabbroni, &c.*)

Nature. The essential symptoms of this disorder are sufficient to demonstrate that it is dependent on some pathological condition of the nervous system, but in what this consists we are wholly ignorant. Some have thought it must be attributed to inflammation of the pharynx or œsophagus, others to congestion or inflammation of the brain, while a third class have considered it dependent on some irritation of the spinal marrow. These views, however, have been drawn from a very limited number of observations, in which particular morbid alterations have led to the theories maintained. But the variety of appearances presented on dissection, and the occasional absence of one or the other, or all of them in particular cases, sufficiently proves that morbid anatomy is as yet unable to furnish us with a sufficiently extended series of facts from which we can deduce any positive conclusions as to the nature or seat of hydrophobia. Did we indeed, infer the cause from the effects, we might with some show of reason attribute the disease to more or less pressure upon the eighth pair of nerves. A careful perusal of the experiments made upon this nerve by physiologists and particularly by Dr. John Reid, of Edinburgh, (*Edin. Med. and Surg. Journ.*, No. cxxxiv.) will show that con-

gestion of the membranes at the base of the brain, producing more or less pressure upon the origin of these nerves, is capable of explaining all the phenomena the disorder presents, viz. spasms of the larynx, accompanied with pain extending to those of the larynx and lower part of the face, dyspnœa, secretion of frothy mucus, pain in the back of the neck, chest, or epigastrium, nausea, vomiting, &c.; while the other symptoms, such as the excited mental faculties, delirium, increased sensibility, &c., may be ascribed to the participation of the cerebrum, the fifth and other nerves, in the morbid action. Had we space to follow this theory, we could satisfactorily show that it is supported by more anatomical, physiological, and pathological facts, than any other, and fully agrees with the researches of the accurate experimenter to whom we have above alluded. If attention during post mortem examinations in cases of hydrophobia were more particularly directed towards this view of the subject, we might be able to speak with certainty regarding it. On this point, however, the present state of science has only furnished us with conjecture. The same may be said of other questions connected with the pathology of this disease, such as the origin of the virus; the changes it undergoes after the bite, and before the commencement of the premonitory symptoms; whether it produces its effects directly or indirectly, by absorption or otherwise; whether the disease is communicable by man, when it arises from other causes besides inoculation, &c. These interesting questions have been fully discussed by various authors, without any positive results having been arrived at, a circumstance which in some degree reconciles us to the necessity imposed upon us by our limits, of not entering into their consideration.

Diagnosis. Hydrophobia, when perfectly developed, presents such peculiarities as readily distinguish it from all other disorders. The bite of a rabid animal may have healed up, however, and have been forgotten long before the appearance of the premonitory symptoms, and under such circumstances these may be mistaken for melancholy and hypochondriasis. The rapid progress of hydrophobia, and the manifestation of the characteristic symptoms of the disorder, such as difficulty of deglutition, dread of water, &c., will soon clear up any doubts that may exist.

Many writers have pointed out the similarity between hydrophobia and tetanus, and undoubtedly they resemble each other in many particulars. In general, however, the spasms in the former are clonic, of short duration, and followed by distinct intervals; in the latter they are tonic, of longer or shorter duration, with remissions only. In hydrophobia the pharynx and root of the tongue are the parts first complained of, and the mouth opens and shuts readily. In tetanus there is almost always pain and stiffness in the muscles of the jaws, which gradually become fixed and closed. Thirst, vomiting, and febrile symptoms, are common in hydrophobia, rare in tetanus. In the first also the mind is usually excited from the beginning, in the latter it is rarely altered, and then only towards the termination. A knowledge of these circumstances can rarely fail in detecting hydrophobia from tetanus, even when it arises independently of a bite. It must not be denied, however, that instances have occasionally occurred, in which the diagnosis has been very difficult. Cases are recorded arising from the bite of a rabid animal, in which, together with all the symptoms of hydrophobia, there was tetanic rigidity of the muscles with complete opisthotonos. On the other hand, traumatic tetanus may exist, with constriction of the throat, horror of liquids, increased sensibility, abundant flow of saliva, and all the symptoms of hydrophobia. Such instances, however, are very rare, and are only to be detected by taking into consideration the causes, period of accession, and progress of the symptoms.

Hydrophobia may be confounded with some rare forms of hysteria. The history of the case, presence of the globus, borborygmi, absence of increased salivary secretion, &c., will distinguish it. Hydrophobia from inoculation is known by the traces of a bite the local symptoms connected with it, and the

accession from the twentieth to the fortieth day, while in that arising from other causes there is no wound, and there are no local symptoms.

Prognosis. Hydrophobia must be considered as one of the most fatal diseases to which the human subject is liable, and by some authors has been thought invariably to terminate in death. Several cases, however, caused by inoculation, are recorded, in which all the symptoms have been present, and yet recovery has taken place. Hydrophobia induced by the bites of rabid animals is much more fatal than that arising from other causes. It has been thought by some that wild animals inflict more dangerous injuries than those which are domesticated, a circumstance which, if true, may be attributed, not to any greater intensity of the virus, but the deeper wounds such animals inflict, and the more perfect inoculation thus occasioned. Wolves also, with regard to which this remark has principally been made, usually fly at the face, while dogs bite through the clothes. Others, however, maintain, that small wounds are more dangerous than large, as in the former the flow of blood is not great, and does not wash away the virus which is deposited.

The proportion which the occurrence of hydrophobia bears to the number of persons bitten is unknown. Mr. J. Hunter has stated that on one occasion a dog bit twenty persons, of whom only one became affected with the disease. In 1780, at Senlis, a dog bit fifteen persons, of whom three afterwards died of hydrophobia. At Brives seventeen persons were bit by a wolf: of these ten died. Of twenty-three others bit by a she-wolf, thirteen died. (*Troillet.*) The chances of escape ought never to be relied on, as no doubt can exist that the individual who has been bitten by a rabid animal incurs great risk, and the prognosis must always be more unfavourable when no preventive measures have been employed, than when excision or cauterization has been had recourse to.

Treatment. A survey of the causes which occasion hydrophobia, as well as the symptoms of the disease when it is fully established, shows that the treatment should be divided into the prophylactic or preventive, and curative.

1. *Prophylactic treatment.* As we shall afterwards have occasion to observe, medicine has little control over the disease when once fully established: the prevention of the disease is consequently the principal means of escaping the extreme suffering and dreadful death which hydrophobia in general occasions. It fortunately happens that we are with tolerable certainty enabled to guard against the invasion of the disease when an individual has been bitten by a rabid animal, and we think it may be truly stated, that every person who has once witnessed the disorder would cheerfully submit to any temporary pain, to give even the chance of being relieved from its horrors. Of all methods the complete excision of the bitten parts, and the immediate application of some powerful caustic to the raw surface, is that which undoubtedly merits the greatest confidence. When this cannot be done immediately from want of instruments or necessary assistance, the wound should be perseveringly washed with tepid water. Dr. Haygarth recommends a continued stream of water from the spout of a tea-kettle, held up at a considerable distance, to be directed upon its surface. Excision, however, is to be had recourse to as soon as possible, and great care should be taken that the operation is performed effectually, and every portion exposed to the animal's teeth entirely removed. It is stated that on one occasion Mr. Hunter, after examining the piece cut out, thought he had removed all that was necessary, but on exploring the surface of the wound he found a hollow had been left which had been exposed to the dog's teeth, and which could only have been discovered after the operation. (*Trans. of Med. Soc.*) This circumstance indicates not only free excision, but a careful examination of the wound afterwards. Many practitioners think that caustic is alone sufficient to destroy the virus, and various remedies of this class have been recommended, as the actual cautery, the nitric, sulphuric, and hydrochloric acids, potassa fusa, nitrate of silver, butter of antimony, &c. Mr. Youatt prefers the nitrate of silver, as it produces a hard, dry, and insoluble eschar, whereas, most of the others produce a soft or fluid mass in contact with the skin

in which the virus is suspended, so that reinoculation may be accomplished. He considers the lunar caustic also, when sharpened to a point, may be applied with more certainty to every recess and sinuosity of the wound. He has operated in this way on 400 persons, and on himself four times after bites from dogs decidedly rabid, and the disease has not appeared. He recommends also that, after the part has been destroyed by the caustic, the wound should be healed speedily, in the mildest manner. In this respect he is opposed to the practice advised by several German physicians, who, by the application of stimulating substances, keep up a state of suppuration for some time. L. M. Axter, senior surgeon at Vienna, applies a blister over the wound, and afterwards dresses it with Pulv. Lyttæ, or some stimulating lotion, for six weeks. He gives also a grain of Pulv. Lyttæ and six grains of Canc. Ocul. internally for six days. During a period of twenty-seven years, no patient thus treated had been brought back to the hospital labouring under the disease. Dr. Hausbrand of Braunsberg employs general bleeding, and makes deep scarifications of the wound, which he washes with salt and water, after favouring the flow of blood as much as possible. He then applies an ointment of Ung. Basilicum and Pulv. Lyttæ, so as to keep up a discharge for three months. He also gives camphor and opium internally for the first three days. Eleven persons bitten by dogs actually rabid escaped after this treatment. Dr. Wendt of Breslau, besides keeping up for six weeks suppuration in the wound by means of Pulv. Lyttæ and irritating applications, employ mercury internally, so as to produce salivation: 180 persons were admitted into the Breslau hospital, of whom half had been bitten by rabid dogs, or supposed to be so, and two only died. All these methods of treatment are infinitely more painful and not so effectual as excision of the part, which we consider ought invariably to be done, whenever the situation of the bite will allow of it; and if not, the nitrate of silver, as recommended by Mr. Youatt, should be well-applied, and the wound enlarged if necessary, in order to allow the cauterization of any sinus or recess on its surface. The application of a small cupping-glass over the bitten part has been recommended by Dr. Barry, and after excision this practice may be useful. Dr. Good advises the application of a tight ligature a short distance above the laceration, which may also be used. Amputation has been thought warrantable in some cases by Mr. S. Cooper, when a limb has been so severely lacerated, that complete excision of the parts is almost impossible or very dangerous. In cases where the smaller bones have been injured, this operation should be performed.

Dr. Marochetti considers that the rabid virus appears in the form of small pustules under the tongue, at each side of the frænum, from the third to the ninth day, and that the prophylactic treatment essentially consists in opening and cauterizing them within twenty-four hours after their formation. He also advises that the mouth should be washed with a decoction of the *genista tinctoria*, of which the patient should drink a pint and a half every day for six weeks. (*Hufeland's Journal*, March, 1824.) In addition to several cases reported by himself, this plan has apparently succeeded in some cases by Salvatori and Rossi. In ten cases however, in which this treatment was adopted by Majistal, five died, which is a very large proportion: probably more would not have been affected if nothing had been done. When these pustules are present, it will be well, as a precautionary measure, to open and cauterize them, but in numerous cases which have been carefully examined they could not be found. It has been supposed that the extremities of Warton's ducts have not unfrequently been mistaken for them. Washing the wound with oxymuriatic acid has been recommended by Wendelstadt and Brugnatelli, and for a short time this remedy was much thought of, but it soon fell into neglect. A case mentioned by Dr. Johnson died of the disease, although excision was practised seventy hours after the infliction of the bite, and the wound washed with oxymuriatic acid.

It has been observed by Dr. A. T. Thomson, that the virus remains latent in the wound, and produces no evil effect until a peculiar state of the constitution favours its action. It is of course impossible to determine the truth of this theory,

but the practical point to be derived from it is, that excision, even some time after the bite has been inflicted, may be useful. Jolly tells us that M. Recamier opened the cicatrices which were tumefied in an individual who had been bitten by a rabid animal fifteen days before, and cauterized them with the crystallized nitrate of mercury. Baths and diaphoretics were also employed, and the patient escaped the disorder, while another person who had been bitten by the same rabid animal, at the same time, perished from hydrophobia. A case is related by Professor Rush, where excision was performed thirty-one days after the bite, even after the hydrophobic symptoms had appeared, and still the patient's life was saved. Dr. Harder relates a case in which, five months after the bite, and eight weeks after excision, hydrophobia appeared, but another excision and cauterization saved the child. In two weeks the symptoms again returned, and a pale and painful excrescence formed in the bottom of the wound. This was excised, the nitrate of silver applied, and recovery took place. (*Petersburg Med. Trans.*, vol. i. p. 170.) These are undoubtedly strong cases in favour of excision or the cautery, some time after the reception of the bite. The longest period at which it may be prudent to have recourse to such a proceeding is undetermined; but we should not hesitate to advise it any time before the fortieth day, if the animal was proved to have been rabid. The cases above alluded to also render it warrantable to excise the part whenever pain or swelling commences in the wound.

Knowing that mental agitation is a powerful exciting cause of the disorder, particularly when the individual is aware that the animal from which the bite has been received is in a rabid state, every means should be taken to tranquillize the mind, and remove imaginary terror. If an individual has been bitten by a dog supposed to be rabid, but which is not so, the animal should be exhibited to the sufferer; but if it have been destroyed under the unfounded apprehension, it will be well to cauterize the wound, and use the same methods as if the animal had been decidedly rabid.

Experience has sufficiently proved that all internal remedies, with a view of preventing the accession of the disease, are unworthy of confidence. Considerable doubts must always exist even with regard to the utility of local prophylactic treatment, so long as the great majority of individuals bitten escape without remedies of any kind having been applied, though there are few physicians who would not recommend, and few prudent individuals who would not submit to it.

2. *Curative treatment.* The result of experience has proved, that no mode of treatment hitherto adopted is capable of arresting the disease when once fully established. A few cases of recovery indeed have taken place, but the remedies which were supposed to have effected these, have failed so frequently in other instances that it may be doubted whether such recoveries are to be attributed to the power of medicine. Of this the reader will judge from the following account of the effects which various therapeutic means have produced.

Sedatives have been most extensively tried with a view of overcoming the nervous excitement. Opium in particular has been largely given, and in all forms without success. Dr. Vaughan gave 57 grains in fourteen hours, besides half an ounce of laudanum in an injection, and Dr. Babington gave 180 grains in eleven hours. (*Med. Records and Researches*, p. 121.) Both cases died. Dupuytren injected the gummy extract with the like ill success. Dr. Booth recommended that 24 minims of the solution of acetate of morphia mixed with 3ij of distilled water should be introduced into the cephalic vein, and repeated at intervals of ten minutes if no effect was observed. (*On Hydrophobia.*) Dr. Brundreth tried this plan, but with only temporary alleviation. (*Edin. Med. and Surg. Journ.*, No. lxxxii.) In another case Dr. J. L. Bardsley did not find it produce any benefit whatever. Dr. Ward advises opium frictions, which in some instances have occasioned temporary abatement of the spasms. Schmidt, Richter, Munch, and Brera, have administered belladonna, but unsuccessfully, when the disease has been perfectly established. The latter writer prescribed it in combination with mercury to the extent of ʒij of the powdered root daily, and has published seve-

ral cases in which it appeared to prevent the attack, even when the early symptoms of the disease were present. (*Mem. Soc. Ital. Scienza Mod.*, tom. xvii.) In the hands of other physicians, however, it has entirely failed. Prussic acid produced only temporary relief in Dr. A. T. Thomson's case, and in several other instances it has been found inert. Tobacco was used by Mr. Sawrey with advantage, and has been found beneficial in relieving the spasms of the muscles of the throat. As we have observed in the treatment of tetanus, it is a most powerful means of overcoming extreme nervous excitement, and seems worthy of farther trial. An infusion of \mathfrak{J} of the leaves in \mathfrak{Z} viij of water, given in the form of enema, is the best method of administration. Cold affusion, energetically applied, is a powerful sedative, and has been employed, though with temporary benefit only. In a case given by Dr. Bardsley; it relieved the burning heat of the skin. Stramonium, acetate of lead, warm baths, &c., have been used without success.

Blood-letting has been recommended by Mead, Boerhaave, Pourpart, Fothergill, Nugent, and others; and has been performed to a great extent with occasional success. Dr. Innes took 116 ounces in four days: this large bleeding produced the greatest possible degree of prostration, but the patient recovered. (*Med. Essays and Obs.*, Edin. vol. i.) Symon (*Edin. Med. and Surg. Journ.*, vol. ix. p. 24.) Shoolbred (*Ibid.*, p. 30.) Wynne (*Particulars of the successful Treatment of a Case of Hydrophobia &c.*) Burton (*Phil. Mag.* Aug. 1805,) and Vogelsang (*Med. Repos.*, vol. iv. p. 500,) bled to fainting with great success. Dr. Shoolbred recommends that the venesection should be performed in an early stage of the disease and from a large orifice. Other instances are recorded, in which this treatment was followed by recovery; but in others it has failed in preventing the fatal termination. Rutherford, Parry, Bosquillon, and Troiliet, have used blood-letting without beneficial result; the latter even thinks that the cases spoken of by Shoolbred were not cases of hydrophobia; and Mr. S. Cooper and Dr. J. L. Bardsley appear to coincide in this opinion. From the published results of this plan of treatment however, when employed at an early stage of the disorder, it appears to have been more beneficial than any other; and in certain cases, where the vascular excitement is much increased, and the constitution robust, may be adopted with every hope of success.

Stimulants and tonics have been given with a view of supporting the system against the prostrating effects of the spasms. Dr. Good was of opinion that the disease wears itself out in six or seven days, and that if the constitution can be supported beyond that time the patient will recover. For this purpose, the different preparations of ammonia, camphor, assafetida, castor, and other stimulants have been largely employed. Musk has been thought by some to be useful, and may be given in large doses combined with opium and belladonna. It can, however, in no way be depended on; when conjoined with cinnabar, and about four ounces of arrack, it forms the Pulv. Cobbii or Turgiensis, which had a short-lived reputation for the cure of this malady.

Electricity and galvanism have been employed occasionally, with temporary benefit. Strychnia and the nitrous oxide gas were given in a case by Dr. Bardsley, but with little apparent effect. Carbonate of iron has been administered by Dr. Elliotson, and the mineral tonics by Dr. Bright, but without effect. The latter also recommends diffusible stimuli, and an injection of the Tinct. Ferri Mur. into the rectum. Acids, particularly the oxymuriatic and acetic, have been used and recommended, both as preventive and curative remedies, by Previtati, Agliatelli, Ancelli, Narcissi, and Brugnattelli (*Giornale de Fisica*, 1821.) Nitrate of silver, plunging in the sea, hydrochlorine, sulphate of quinine, turpentine, and other remedies of this class, have been given, and found useless.

Mercury has been extensively employed by numerous practitioners. It was first recommended by Dessault, and afterwards by James, Kaltschmid, Du Choisel, Andry, Sebig, Königsdörfer, Walther, and others. Its beneficial effects are wholly denied by Frank, Girtanner, De Moneta, Raymond and several other

writers, and experience has proved it has little power in controlling the symptoms. Arsenic has been given by Dr. Marcet, combined with opium and iron, without benefit.

Of sudorific remedies, sweating by means of heated air has been recommended, but the time necessary to produce any effect on the system by these means is apparently hostile to its use. Diuretics have been highly extolled, especially cantharides, which has been employed for many ages in this disorder, and has been much praised as a prophylactic, by Axter of Vienna. Emetics have been occasionally given. Dr. Satterly thought them advantageous in a case in which they were employed by him. (*Med. Trans. of the Coll. of Phys.*, vol. iv.) Purgatives should be given to procure the necessary alvine discharges, but do not appear to have been much relied on by practitioners.

Injection of warm water into the veins has been tried by Magendie, from his having observed nervous debility produced in animals which had been subjected to it, and that the fluid parts of the blood were diminished by the impossibility of taking fluids, and the great cutaneous and pulmonary transpiration. A pint of water heated to 30° Reaumur was injected into the arm of a man labouring under advanced and violent hydrophobia. Immediately after the operation the patient became tranquil, and the pulse fell in twenty minutes from 150 to 80. The spasms ceased, and the individual drank a glass of water without difficulty. He continued to improve until the fifth day, when swellings and acute pains in the wrists, knees, and elbows, appeared, and an abscess formed in the leg, occasioned by the broken points of two lancets, which remained in the foot, from former unsuccessful efforts to bleed. He died on the ninth day. The swollen joints, were found filled with pus, and it is probable these secondary purulent deposits were the cause of death. Dr. Pearson recommended the injection of warm water in small quantities, impregnated with narcotic substances, into the veins, in order to relieve the spasms which prevent deglutition, followed up by cathartics, antispasmodics, the mineral and vegetable tonics, and sponging the body with cold water and vinegar.

Trachotomy has been proposed by Mr. Mayo as an expedient in this disease. Dr. Hunter speaks of two cases benefited by running.

Several other remedies, supposed to act as specifics, have been employed. The ash-coloured liverwort was formerly so popular, as to be admitted into the London Pharmacopœia of 1721, under the name of *Pulvis Antilyssus*. The thalictrum flavum and angustifolium, and the delphinium consolida, are plants which were considered specific in some parts of Russia. (*Med. Repos.*, vol. ii. p. 153.) The guaco juice has been recommended by Sir Robert Kerr, but has been found inert in several cases. In America, the sartellaria laterifolia has been extolled by Dr. Spalding. The bite of a viper has been tried in some cases, with the idea that the venom of this animal would counteract the rabid virus. (*Dict. des Sciences Med.*) The alyssa plantago, ophiorrhiza mungos, genista tinctoria, have been praised, as well as phosphorated water, soap lees, and other remedies, which are now abandoned.

In the midst of so many remedies which have been lauded by partisans, and in turn found to be useless—with a knowledge that the most powerful drugs are apparently inert—overwhelmed with the sad conviction that the learning and talents of the most experienced and energetic physicians have utterly failed in arresting the progress of this dreadful malady, the practitioner, when called upon to act, must still respond to the awful question—What is to be done? It is in such a situation only that he can experience the benefit of having studied the whole train of nervous diseases, of being able to detect and appreciate the analogies and dissimilarities which exist between each respectively, and of having deduced from the whole such general principles, as will enable him to act conscientiously in every case, as far as the present state of the art will permit. In hydrophobia, therefore, as in tetanus, and several other nervous disorders, no exclusive line of treatment should be followed. If the patient exhibit signs of plethora, be

strong, of a vigorous constitution, and there be symptoms of increased vascular excitement, venesection, cupping, or the application of leeches to the occiput or back of the neck, and antiphlogistic remedies should be actively employed, so as to make an impression upon the nervous system. But if there be evidence of anæmia, and general depression of the vital powers, stimulants and tonics are indicated, and should be used energetically. With a view of overcoming the spasms, the tobacco enema, or cold affusion, may be had recourse to according to circumstances; and the same kind of treatment should be persevered in, as has been recommended for acute tetanus. (See TETANUS.)

NEURALGIA.

Definition.—Symptoms.—Varieties.—Diagnosis.—Causes.—Nature.—Treatment.

THE term Neuralgia (derived from *νευρον*, a nerve, and *αλγος*, pain,) is applied to a painful affection in the course of a nerve, not necessarily referrible to inflammation or to any appreciable organic change. The pain is in some instances confined to the trunk of a nerve, in others extends to the branches, and occasionally proceeds from the branches to the trunk. It is sudden in its onset, often commencing with, rather than acquiring by degrees, its full intensity. The patient is usually at a loss for words fully to describe the suffering, but often speaks of it as shooting, stabbing, or scalding. The pain is in most instances aggravated by a slight touch, but relieved by firm pressure. It may be intermittent, remittent, or without a distinct interval. Intermission is a more frequent characteristic than is usually supposed, and it commonly attends neuralgia from mechanical injury. The attack is often ushered in by numbness, or a sensation of creeping or pricking in the part affected; and its cessation may be preceded by itching. Exalted sensibility of the part, muscular agitation, cramp, and even tetanic stiffness, may follow. The phenomena are in some degree diversified according to the peculiar function of the suffering organ. In the intervals between the paroxysms, a sensation of obtuse pain or numbness may be experienced, or there may be perfect freedom from all uneasy feeling. The accessions gradually become more and more violent, and the intermissions less defined, till at last the patient enjoys no immunity from suffering, except when under the stupefying influence of sedatives. A severe case of this description probably occasions the greatest degree of anguish to which the human body is liable; and in its full extent of duration and intensity, is perhaps "beyond the endurance of human fortitude."

Hippocrates and Galen appear to have confounded *tic douloureux* with tooth-ach, and to have described other neuralgic affections as varieties of gout and rheumatism. André, in 1756, in a work on a very different subject, introduced remarks showing his knowledge of their separate character. Contunnius, in 1770, specified the discriminating marks between gout and sciatica, and described with considerable accuracy the cubito-digital variety of neuralgia. His observations were followed by those of Fothergill, Pujol, Thouret, and Fortsmann on *tic douloureux*. But the views entertained of the affection were very incomplete until Chaussier, in 1802, first introduced the name neuralgia, accurately described the disorder as affecting the nervous cords, and gave a faithful account of several varieties. Since the publication of Chaussier's remarks, the disease has attracted a degree of attention, in some degree commensurate with its importance. It is now generally allowed not to be limited to any particular part of the body; and evidence is continually accumulating in support of the opinion of M. Jolly, that as wherever there is blood there may be inflammation, so wherever there is a nerve, there may be neuralgia. We cannot deny even to the ganglionic system of nerves, a liability to exalted sensibility. Cruveilhier has shown by experi-

ment, that spasmodic cough may be produced by irritation of the pneumo-gastric nerve. Various affections, such as asthma, dyspnœa, pertussis, and nervous vomiting, have been referred to a similar condition by Pinel, Delens, Bland, and Lobstein. Laennec attributed angina pectoris to a similar source. Legond has written an interesting monograph on colica pictorum, describing it as a neuralgic affection of the sympathetic nerve. Gastrodynia, and various analogous disorders, have also been traced to a similar condition by Teale, Marshall, Griffin, and others, in our own country. On these interesting subjects it may be sufficient to mention, that such affections of ganglionic nerves are generally attended with altered or increased secretion of associated organs; that they are more frequent in women; and that the exacerbations, according to Jolly, instead of occurring, as in ordinary neuralgia, chiefly in the evening, appear at night or early in the morning. There is no reason to believe, that any of the nerves of the cerebro-spinal system, from the root to the ramifications, enjoy immunity from neuralgia. A severe variety of headach (termed *cerebralgia*) appears to depend on a neuralgic condition of the membranes of the brain. A similar state of the membranes of the spinal cord occasionally exists, and may be associated with alterations of the voice, spasm of the œsophagus, cough, dyspnœa, vomiting, colic, cramp, &c. (*Nouv. Biblioth. Méd.*, 1827. Gassaud and Costa.)

The sub-cutaneous nerves, especially those of parts provided with numerous muscles, are, however, most subject to the disease; and the most frequent seat of the intense form is the head and face, in consequence of the number and sensitiveness of the nerves in this situation, as well as their superficial arrangement, and perhaps, also, from their intimate connexion with the sympathetic, and consequent susceptibility of impression from conditions of the abdominal viscera. Bell and Shaw have questioned the liability of the portio dura to neuralgia, but there is reason to believe that its branches are occasionally affected, although much less frequently than those of the fifth pair of nerves. In forty cases related by Bellingheri, thirty-eight affected the fifth pair; only two the portio dura. It is the third branch of the fifth pair which is most liable to this distressing complaint in its most intense form; and to this variety, from the suddenness of its onset, the term *tic douloureux* was originally given by André. It constitutes the *dolor faciei* of Fothergill and Fortsmann, the *dolor faciei typico character* of Siebold, the *neuralgia facialis* of Chaussier, *neuralgia spasmodica* of Kerrison. It is denominated *trismus clonicus* by Ackemann, *trismus dolorificus* by Sauvages, *hemisrania idiopathica* by Darwin, *rhumatismus canerosus* by Vogel, *febris topica* by Van Swieten, *ophthalmodynia periodica* by Plenck, and by others *prosopalgia*, *dolor faciei atrox*, &c. When the supraorbital branch is affected, we generally find redness, sensibility, and pain of the eye, shedding of tears,* swelling of the veins, and throbbing of the arteries in the neighbourhood. The attack generally comes on in the evening, and lasts most of the night: sometimes the affection is confined to the eyeball, constituting a severe variety of neuralgia, which has been well described by Mr. Middlemore: the pain is usually intermittent. There is great intolerance of light, especially during the paroxysms, and the pupil is in most cases contracted. When the *suborbital* nerve suffers, the pain may be confined to the eyelid, or it may extend to the dental branch, involving the maxillary sinus, palate, base of the tongue, and side of the face, and through the communications of this nerve with the portia dura, convulsive actions of the lid, cheeks, and upper lip, may be produced. Shedding of tears and excretion of nasal mucus are common accompaniments,† but sometimes these parts are remarkably dry.

When the *maxillary* branch is the seat chiefly implicated, the teeth or their

* It is remarkable that cases which have involved the lachrymal glands often leave a liability to shed tears even during sleep and in the absence of emotion.—AUTHOR.

† Dr. Macculloch on one occasion observed a pint of mucus to distil from the nostrils in a short space of time.—AUTHOR.

sockets, the sides of the tongue, the lips, and chin, suffer. This is said to be the least regular in its progress of all the varieties of facial neuralgia, and to affect the right more frequently than the left side. When associated with trismus, or with lateral distortion of the face, the disorder may be more obstinate, but the pain is generally less severe. Sometimes the complaint is limited to a single nervous twig, as to the labial, dental, or palpebral; but in other instances it extends to the neighbouring parts: it is generally confined to one side, but sometimes attacks both sides together, or passes alternately from one side to the other.

In all these varieties the first attacks of pain may be so slight as to attract little attention, but their severity gradually increases. The duration of the paroxysm may be only a few seconds, and seldom exceeds a minute. Sometimes repeated attacks occur in a few minutes, at other times the intervals are considerable. The suddenness of the pain stops abruptly any conversation in which the patient may be engaged; and rocking in his chair, or writhing with anguish, he places his hand on the face, which he beats, rubs, or presses. He knits the brow, compresses the eyelids, draws up the lips into a sardonic grin, and fears either to speak or to masticate. When the complaint has been long protracted the appetite fails, a feverish state arises, the patient obtains no rest, except under the influence of opiates, and sometimes becomes delirious from the violence of the pain.

The affection described by Itard under the name of *Otalgia*, and which is peculiarly apt to occur in infants and in children shedding the first set of teeth, evidently belongs to this class of disorders, differing from otitis in the lancinating and intermittent character of the pain and the absence of fever. The paroxysm is frequently accompanied with deafness, and when existing in adults, otalgia often associated with facial neuralgia.

The *cervical* nerves have been occasionally affected with this disorder, in consequence of injury occasioned either by the application of leeches (*Nouv. Bibl. Méd.*, 1827,) or from a wound received in the operation of opening the jugular vein.

Of the *intercostal* nerves, that which runs between the eighth and ninth ribs is most liable to suffer, particularly in women. A neuralgic condition of the *lumbar* nerves, constituting one of the most important varieties of lumbago, has been denominated *illioscrotal* and *spermatic*: the anus, spermatic cord, scrotum, and ureter, are the parts chiefly affected; and in women the vulva: the *cubito-digital* variety of neuralgia described by Cotugno and Chaussier is the most frequent to which the upper extremities are subject. The pain passes between the olecranon and tubercle of the humerus, and runs down to the fore-finger and to that adjoining.

The *femoro-popliteal* (commonly called *sciatica*) is perhaps the most common, and the best known. The pain sometimes seems to arise from the ischiatic notch; at other times from the origin of the sacral nerves, some of the divisions of which it follows. It is particularly liable to occur in pregnant women, in consequence of the pressure of the gravid uterus. Neuralgia of the *plantar nerve* has been known to alternate with that of the facial.

These varieties have been mentioned as among the most frequent affections of single nerves, and it is unnecessary farther to extend the enumeration.

Parenchymatous, muscular, and membranous structures are also liable to be affected. Hepatalgia and hysteralgia may be mentioned as examples of neuralgia of parenchymatous tissue. The bruised feeling attending fever, and the muscular pains depending on atmospheric vicissitudes, are examples of muscular neuralgia. To the membranous variety may be referred some intensely painful affections of the pleura and peritoneum, occasional examples of wandering gout, and not a few of the affections of the periosteum, often attributed to syphilis or mercury. Neuralgic affections of the joints might be noticed as instances of membranous neuralgia, but they occur most frequently in persons subject to hysteria, and

have therefore been described in the dissertation on that complaint. Some intermittent affections of the nostrils, bronchial tubes, and conjunctive membranes, as well as of the urethra, may be arranged in the same division. A tertian variety affecting the last-mentioned part, has been described by Professor Fulci. Neuralgia of the rectum occasionally occurs: in a case described by Busche, it existed only during the first three months of pregnancy. A neuralgic condition of the skin may present itself, sometimes as a symptom of internal disease, at other times as a primary disorder. The "épidémie de Paris," which occurred in the spring of 1828, and which is described by Chomel in the *Journal Hebdomadaire*, No. ix., affords a remarkable example of cutaneous neuralgia: it began in persons previously healthy, with sensations of pricking, severe pain, and acute sensibility of the integuments of the hands and feet; subsequently the sensibility of the affected parts was diminished or abolished, but in most instances was gradually and spontaneously restored.

Herpes and other eruptions are occasionally preceded by pain of a neuralgic character.

Glandular organs sometimes suffer severely from the complaint. The liability of the lachrymal gland to the malady has been already noticed. Sir A. Cooper has accurately described neuralgia of the mamma, under the designation of "the irritable breast." It is almost confined to patients between the age of fifteen and thirty. Sometimes both breasts are affected, at other times only part of one. In cases of long duration, the gland is sometimes slightly enlarged, but in most instances is not visibly altered. The pain darts like electricity into the part, shoots to the axilla, shoulder, inner side of the elbow and fingers, or passes by the sides of the body to the hip. There are alternate feelings of heat and cold in the part. The patient is unable to rest on the side affected, and the weight of the breast sometimes occasions intense pain. One or more lobes are exquisitely tender, and very severe pain, often of some hours' duration, is produced by handling them. Vomiting is sometimes induced by sympathetic disturbance of the stomach. The complaint may continue for months or years without intermission.

An interesting example of neuralgia of the kidneys has been described by Dr. Macculloch. It assumed an intermittent character, and the secretion of urine during the fit was more abundant than in diabetes.

When the testis is affected with neuralgia, some part of that organ, or of the epididymis, is exquisitely tender, so as to oblige the patient to rest in the recumbent posture, and on the side opposite to that affected. The increase of pain produced by pressure or motion, sometimes continues for a considerable time afterwards. Sympathetic vomiting is sometimes excited by the violence of the pain.

A variety of neuralgia depending on a small tumor involving the nervous structure has been remarked by Camper (*Demonst. Anat. Pathol.*, lib. i.,) Cheselden and Bisset (*Mem. of Med. Soc. of Lond.*, vol. iii; *Med. Facts and Obs.*, vol. vi,) but was first fully described by Mr. William Wood (*Edin. Med. and Surg. Journ.*, vol. viii,) under the denomination of "painful sub-cutaneous tubercle." The pain occurs in paroxysms, lasting from ten minutes to two hours, gradually increasing in severity, and leaving a bruised feeling. The pain is increased by changes of atmosphere. It is also produced, or, if previously existing, is much aggravated by pressure. The complaint is most common in women, and in a case related by Dr. Bisset, was invariably more severe during pregnancy.

Angina pectoris is probably a neuralgic affection of some of the cardiac nerves, sometimes arising from mechanical irritation, occasioned by organic disease of the heart or its vessels; but this subject is still involved in uncertainty.

It may be questioned, whether any of the affections which have been designated *Gastralgia* and *Enteralgia* can be strictly considered neuralgic.

Diagnosis. The exquisite form of neuralgia is readily distinguished from every other malady by the nature of the pain, and by the suddenness of its onset. In less severe attacks, the situation of the pain in the course of a nerve is generally sufficiently characteristic. In neuritis there is decided tenderness on firm

pressure, with heat, redness, and other signs of inflammation, and without the sensation of coldness, so common in neuralgia. It is, however, important to remember, that inflammation of a nerve may occasionally precede or accompany neuralgia.

The pain produced by otitis is less lancinating and intermittent than that of otalgia, and is not relieved by the introduction of anodynes into the ear. The pain of common toothach is more constant, is increased by touching with a metallic instrument, and is often attended with swelling of the gums. But it must not be forgotten, that the neuralgic variety of toothach is by no means uncommon: it may attend or alternate with other forms of neuralgia, is produced by the same causes, and resembles them in the nature of the pain. The pain of rheumatism is usually gnawing, pungent, continuous, or remittent, while that of neuralgia is lancinating or thrilling, periodical, and often relieved by pressure.

Causes. Among the *predisposing* causes may be mentioned the nervous temperament, adult age, residence in marshy countries, intellectual exertion, moral emotions, and long-continued watching. Dr. Baillie and others agree, that the disease has lately become more frequent than formerly; and, although a more accurate diagnosis, by separating the disease from rheumatism, may have conduced to the apparent increase of frequency, yet there is good reason to believe, that the anxieties associated with a state of progressive civilization have increased the prevalence of the affections. The question, whether one sex be more subject than the other to this disorder, must be considered as undetermined, André, Baille, Samuel Fothergill, Sauvages, and Barnard, considering it more frequent in men, while Pujol, John Fothergill, and Hutchinson, regard it as more common in women. The observations of Thourët, however, strongly support the former opinion. He examined the question with considerable care, and found that of the cases which fell under his observation, the proportion of men to that of women suffering from the complaint was as two to one. The disease may be induced by any cause which deranges the digestive organs, or which disturbs the balance of the circulation. Long fasting, or free bleeding for the cure of inflammation, may be followed by a paroxysm; occasionally, the opposite condition of plethora may produce it.

Of the *exciting* causes most commonly enumerated, viz., blows, fright, suppression of sanguineous discharges, currents of cold air and damp, the last is probably the most efficient. Of forty cases described by Bellingheri, two were attributed to fright, two to wounds, two to suppressed discharges, and thirty-four to damp. All the forms of the complaint prevail most in spring, and during easterly winds. Neuralgic ophthalmia is most frequently met with in places where intermittents are common: it is, for example, prevalent on the coasts of the Mediterranean, at Tripoli, and on the shores of Barbary, at Rome, Naples, and Florence, and at Valentia and Albatéra. In connexion with the relation existing between neuralgia and toothach, it may be interesting to mention the observation of Captain Smyth at Villa Cidro in Sardinia, that the women who cultivate the marshy plain are noted for bad teeth, while those of the men who reside on the mountains are remarkably sound. Hæmorrhoids and stricture of the urethra sometimes induce a liability to neuralgic affections, particularly of the lower extremities.

Nature. The opinion of Cabanis and of many of the ancients, that the disorder depends upon an arrest of the nervous fluid, although founded on an assumption, has the support of many of the moderns, and is not without plausibility. Whatever may be the nature of the nervous influence, its proportionate distribution among the organs of sensation, motion, and intelligence, seems to be essential to the healthy state. Many phenomena are most readily explicable on the supposition of a change in the direction of the nervous energy. It is, perhaps, through the intervention of such a change, that pain and convulsion tend to counteract each other, while delirium and drunkenness may suspend both; but we pass from these speculative views to notice the appreciable lesions which have been found associated with the disease.

Cotunnus, Dr. Sayer, and others, have observed a gelatinous secretion under the neurilemma of affected nerves. Cirillo attached importance to thickening of this structure; a condition which was also observed by Mr. Earle in the portion of the ulnar nerve, which he removed in a case of neuralgia of the arm. Such appearances must, however, be allowed to be only occasional, probably dependent on long-continued disease, and more frequently associated with rheumatic affections than with true neuralgia.

Enlargement of the vessels of affected nerves is a much more frequent occurrence. It was described as an accompaniment of the complaint by Bichat and Van de Keer, and, during the late war, was frequently detected in those who had suffered from sciatica. It is probable that in cases of shorter continuance, such a condition may have existed, but have disappeared after death. We have often observed venous congestion about superficial nerves, affected with neuralgia. The necessity for a balance between the arterial and venous system to preserve the healthy condition of nerves, and the fact that these affections are often relieved by warmth, are favourable to the opinion that this congestive state may frequently exist. At the same time it must be acknowledged, that such a state does not appear essential, since in cases of long duration, examined after death by distinguished pathologists, such as Chaussier, Desault, Cooper, Andral, and Rousset, the nerve has been found in appearance perfectly healthy.

In several instances some irritating cause has been discovered between the part to which the pain is referred and the nervous centre. A case of fourteen years' duration is described by Mr. Jeffries, depending on irritation from a piece of china imbedded in the face, and which was immediately cured by the removal of the foreign body. Sir H. Halford, in his interesting essay on *tic douloureux*, has related a case produced by exostosis arising from a sound tooth, and has referred to cases in which disease of bony canals through which nerves pass, or spiculæ of bone pressing upon nerves, have been associated with neuralgia. In an example of *tic douloureux*, which occurred at the Richmond Hospital, in Dublin, the gasserian ganglion was fibro-cartilaginous, and as large as a nutmeg. In some instances the irritation is communicated from distant nerves by sympathy, as in the case described by Mr. Lawrence, in which neuralgia of the thumb was occasioned by the pressure of a pivot tooth on the nerve of an old fang.

Various causes of irritation affecting any part of the cerebro-spinal axis seem capable of producing the complaint. Dr. Marshall has related some remarkable instances, in which aneurism of the aorta had occasioned absorption of the bodies of some of the vertebræ, and produced pressure on the spinal cord, but without occasioning any observable change in its structure. In one of these cases, in which the arch of the aorta was affected, and the bodies of the fifth, sixth, and seventh dorsal vertebræ were absorbed, the patient frequently suffered from a sensation, as though struck forcibly with the fist or by an electrical shock on the fifth, sixth, and seventh ribs of the left side, and afterwards felt as if burnt in that situation with a hot iron. In another case, in which the descending aorta was affected, similar shocks, followed by a burning sensation, were experienced to the left of the linea alba. It is worthy of notice, that, in both these patients, drawing a silk handkerchief, however lightly, over the affected parts from the mesial to the dorsal aspect, occasioned intense agony, whilst drawing the handkerchief in the opposite direction was not attended with suffering. Several other practitioners, particularly Player, Brown, and Teale, have traced an important connexion between a morbid state of the spinal cord and various neuralgic affections; and we have witnessed some remarkable phenomena resulting from blows upon the back, favourable to the same view. In some of these cases there was an alternation of neuralgia with cutaneous eruptions of a scaly character. Alternation of the complaint with herpes has been noticed by Dr. Bright (*Reports of Medical Cases.*) in a case of intercostal neuralgia, and by M. Jolly in the cubito-digital variety (*Dict. de Méd. et Chir.*;) and M. Recamier mentions two cases of sciatica in which zona appeared, but in four days entirely vanished. This is not the place to adduce evidence of

connexion between certain cutaneous eruptions and affections of the spinal cord; but it may be advanced as a plausible opinion, that when there is disorder of many parts in succession, there is some focus of irritation, and it is reasonable to suspect the medulla spinalis as the great medium of metastasis. Although the researches of pathologists have failed to prove that any organic change is necessarily concerned, yet we feel authorized to conclude, that some cause directly interfering with the functions of the brain or spinal cord, is generally present in neuralgia, and that the causes of the complaint commonly exert their influence through the medium of these organs.

Treatment. Few parts of the records of medical practice are more unsatisfactory than those which relate to the treatment of this distressing affection. The long list of remedies, alternately recommended and discarded, furnishes a forcible evidence of their inefficacy. External applications of every kind, tar, cantharides, and even the smoking entrails of live pigeons, have been successively employed. The internal use of every variety of anodyne and of numerous metallic salts, has led to repeated disappointment. Lentin honestly confesses, that of fourteen cases which he treated, he did not succeed in curing one. Dr. Baillie observes, that he has known medicine produce an intermission of some months or even a year, and the division of a nerve suspend the complaint for two years, but that he had not witnessed a case of permanent cure; and Dr. Fothergill closes his melancholy list of unsuccessful remedies with the remark, that we must look to the influence of moral agencies. Dr. Fothergill's observations on the subject of magnetism, a measure adopted in his day in the treatment of neuralgia, may not be without interest at the present time. His words are, "In some few cases where the disease was recent, and the pain slight, the use of magnetism certainly procured case, but merely, I should conceive, by forcibly acting upon the imagination like the modern tractors and all such absurdities with which the credulity of the public is daily gulled and deservedly duped. Indeed, it is much safer and more prudent to ease people of their superabundant cash with a patent, than to dive into their pockets without one: the one practice is attended with riches and honour, the other with infamy and disgrace." It must be acknowledged that the power of the imagination over the complaint is often considerable. Dr. Macculloch, for example, has related a case which the gibberish of an old woman charmed away, after the failure of arsenic.

Although, from the effect of modern improvements, the disease is now found often to yield to scientific treatment, yet we have too frequently to deplore the inefficacy of remedies.

There can be no doubt that the probability of successful treatment must in a great degree depend on the accuracy with which we discriminate the peculiarities of the individual case, and adapt our remedies to them. With a view to this object, it will be important to distinguish the disease into the idiopathic and the sympathetic forms; the first depending on a primary derangement of some part of the nervous system, the second on derangement of some other organ.

In every instance it is important to examine the parts in the neighbourhood of affected nerves, and also to investigate the condition of the spinal cord. If any part of the spine be found particularly tender, it will generally be expedient to abstract a little blood from the neighbourhood, and subsequently to employ counter-irritation by means of blisters or tartar emetic ointment. If there be pain of head, flushed cheeks, and dizziness, the loss of blood will be desirable; and this measure will often convert irregular into regular neuralgia. Mr. Teale has related many cases, some of considerable severity, in which this plan proved remarkably efficacious. We have adopted the same treatment with similar success, and have occasionally derived great advantage from the subsequent use of spirit of turpentine in doses of ʒj twice or thrice a-day, especially in cases in which psoriasis had also existed. This treatment proved rapidly efficient in a case of hysterical neuralgia of some years' duration, recurring daily in severe paroxysms, in which tenderness and puffiness, previously unsuspected, afterwards ascertained to have been

produced by a blow, existed over the upper lumbar vertebræ. When concurrent causes of irritation are removed, such as constipation of the bowels and torpor of the liver, it will be important to ascertain whether the attacks partake of an intermittent character. Should this be the case, whether the pain be superficial or deeply seated, attended or unaccompanied with fever, sulphate of quinine will be found the most effectual remedy. It may be advantageously combined with anodynes: those of a milder character, as the tincture of henbane, occasionally prove sufficient, and should first be tried; but if they prove inefficient, the sedative solution of opium, or the black drop, should be substituted. Dr. Bardsley prefers the acetate of morphia to all other preparations of opium, and has related several cases of neuralgia cured by that remedy alone. (*Hospital Facts and Observations.*) Small doses of quinine often prove adequate to the relief of the symptoms, but they sometimes require to be increased even to the extent of a scruple or half a drachm several times a-day. An interesting case illustrative of this fact, and having a manifest relation to intermittent fever, is described by Sir B. Brodie in one of his lectures on nervous affections.

In cases not characterized by distinct intermissions, the sesquioxide of iron is a more suitable remedy, and is perhaps peculiarly efficacious when there is a deficiency in circulating energy. There is probably no medicine, the claims of which to attention in the treatment of common neuralgic affections are founded on so many recorded instances of success; and the liberal manner in which Mr. Hutchinson published his observations on the subject, affords one of the many examples of disinterested devotion to the public welfare of which the Medical Profession may be justly proud. In some instances a dose of ten or fifteen grains several times a-day will be found sufficient; in others the quantity may be increased even to half an ounce for a dose. We are disposed to consider arsenic as inferior both to quinine and iron in the scale of remedies for neuralgia, and to regard it as less safe and less effectual; it will, however, occasionally succeed after the failure of those medicines, where we wish to produce an alterative effect rather than to make a strong impression on the system.

The pills of Meglin require some notice in consequence of the importance attached to them by some French physicians. They consist of equal parts of oxide of zinc, powdered valerian, and extract of henbane. Meglin in one case gave forty pills night and morning; but in others only three could be borne twice a-day. Many instances of their successful employment are recorded in the French periodicals. (*Journ. de Méd. et Pharm.*, t. xxii. xxvii; *Biblioth. Méd.*, t. xlviii.) Considerable expectations were once entertained from the trial of strychnia; it has, however, been given to the extent of producing subsultus tendinum without any relief to the symptoms. Anodynes must be regarded rather as remedies of a symptom, than of a disease; we have rarely found them productive of more than temporary advantage, although we have reason to think that belladonna deserves a careful trial, and, if well prepared, may prove of considerable value, the *Liquor Belladonnæ* (*Batley*) having occasionally appeared to be productive of permanent benefit.

Extract of stramonium, in doses of from half a grain to two grains three times a-day, has sometimes given relief, but at other times it has been carried to the extent of producing narcotism without any advantage. (*Med. Chir. Rev.*, vol. xxii. p. 72.) Dr. Fott (*Lon. Med. and Phys. Journ.*, Sept., 1832,) has employed the tincture with good effect in doses of fifteen minims every three hours. Mr. Lawrence prefers conium to all other narcotics in this complaint (*Med. Chir. Rev.*, vol. xxii. p. 565;) and other authors have recommended extract of aconite. There can be little doubt that the preparations of opium are decidedly the most entitled to reliance, and when introduced into the rectum they are at once more safe and efficacious than when administered by the mouth. The mineral waters are entitled to great attention as remedies in this complaint, and the Carlsbad has been the most frequently successful. It appears not only to correct the condition of the liver and other digestive organs, but also to improve the state of the ner-

vous structure: many obstinate cases have recovered under its use. It is scarcely necessary to observe, that the advantages of the water may now be secured at the German Spa at Brighton, almost as effectually as at the natural spring. The experiments of Flourens, showing the production of congestion of different parts of the nervous system by different remedies, encourage us to hope that means may eventually be discovered, of acting on the nervous functions without disturbing other processes.

External applications of various kinds have been strongly recommended. Mr. Scott sometimes employs a combination of mercurial ointment, and tartarized antimony—in other cases an ointment of iodide of mercury; but the irritation produced by these applications is considerable, and the benefit derived doubtful. Blisters have been occasionally applied, but the opinion of Heberden, that they are calculated to aggravate superficial neuralgia, is supported by recent experience, and their employment is now almost confined to the treatment of sciatica. The application for a few minutes of lint dipped in strong solution of ammonia, covered so as to prevent evaporation, is recommended by Dr. James Johnson. The production of pustules by means of friction with croton oil has been occasionally useful, as, for example, in some cases of sciatica related by Andral.

The application of the moxa proved useful to patients treated by Dr. Duncan and others in this country, and also by several French practitioners. Most of these cases, however, were affections of the sacro-ischiatic nerve. In ordinary neuralgia little could be expected from the remedy unless severe spinal irritation were present, and the moxa be applied near the affected part of the back.

Electricity has been occasionally recommended, but Dr. Macculloch tried it in vain for many years, notwithstanding all the facilities afforded for the experiment by a military hospital.

During the last thirty years, the Indian practice of acupuncture has been sometimes adopted in this country; and Dr. Osborne (*Dub. Med. Journ.*, vol. xii.,) who regards the disease under consideration as a modification of paralysis, has made many experiments on the subject, which lead him to be sanguine respecting the efficacy of this measure in many cases of neuralgia, and to consider it as the most valuable addition made of late years to European practice. In sciatica, Dr. Osborne rarely found acupuncture fail to relieve, excepting in cases in which, from the aggravation of the pain on coughing, there was reason to apprehend disease of the theca vertebralis or in the pelvis. The experiment is perfectly safe, since it appears from the experiments of Cloquet, Bretonneau, and Carraco, that well-tempered sewing needles may be thrust with impunity through any structure of the body, through the liver, lungs, intestines, or arteries.

Various external applications of a soothing character have been used with uncertain advantage. Distilled cherry-laurel-water has been occasionally found an efficacious lotion. Dr. L. Broglia del Persica has given an account of its successful employment in ten cases. (*Annali Univers. di Méd.*, 1832.) Its use is perfectly safe and easy, and it deserves a more extended trial. The application most depended on by many of the French practitioners, is the cyanuret of potassium: it was particularly recommended by Buttigny, Roubiquet, Villaumy, and Bally; and Lombard of Geneva has given a favourable report of its virtues. He sometimes employs an ointment containing from two to five grains of the cyanuret to the ounce of lard, but prefers a lotion containing from one to four grains in an ounce of water. He considers it inefficient in sciatica, and in neuralgic cases complicated with inflammation. The few experiments made with the remedy in this country have not prepossessed practitioners with any very strong opinion of its efficacy.

A lotion composed of equal parts of prussic acid and solution of acetate of lead is sometimes useful, and, in the less exquisite cases, relief may often be derived from a solution of extract of belladonna, or of opium in camphorated oil. Sprinkling half a grain or a grain of morphia on a blistered surface is often found productive of great relief; but caution must be observed in the employment of a

remedy, which, even when applied in the endermic method, is capable of producing a very powerful effect upon the system. Some French physicians have introduced the remedy by inoculation into the affected part with advantage: it may be mentioned, as an interesting result of this procedure, that a tubercle surrounded by an areola is formed upon each puncture. The application of steam by means of a suitable apparatus to the part affected is strongly recommended by Dr. Macculloch, who has found it invariably alleviate and often remove pain.

We have made occasional trials of veratria ointment, and concur with those who believe it to be an application of little value in neuralgic complaints. We entertain, however, a different opinion of aconitine, having found it, in the proportion of one or two grains to two drachms of lard, peculiarly effectual in arresting the pain in several instances of cubito-digital and frontal neuralgia. Some cases illustrative of its utility, have also been narrated by Mr. Skey, (*Med. Gaz.*, Nov. 1836.) the one of nine, the other of eight years' duration. Although we cannot expect any local application to effect a radical cure, yet the arrest of pain has advantages beyond those of mere temporary relief. Pain increases the sensibility of a nerve; the sooner, therefore, the habit can be overcome, the greater is the success likely to be produced by measures adapted to the constitutional condition.

The practice originally recommended by Galen, of dividing nerves or amputating limbs affected with neuralgia, after the failure of remedies, although on a few occasions successful, as in the cases treated by Kelson, Cooper, Thomas, and Cruikshanks, derives no support either from philosophical reasoning, or from the average results of the experiment. Some very affecting cases are recorded, in which a succession of amputations was resorted to in vain. Whilst, on the other hand, instances in which a proposed operation has been deferred, have spontaneously recovered.

When, as often occurs, many parts are involved in the complaint, the presumption for its constitutional origin is strong; and the disease being in common instances so often connected with the condition of the nervous centre, we can readily understand that, although a severe operation may by the violence of the shock suspend the affection, yet that is not a measure calculated to ensure permanent relief.

Treatment of Sympathetic Neuralgia. The most important of the causes of sympathetic neuralgia are derangements of the digestive organs, hysteria, and rheumatism.

1. A slight degree of gastric or intestinal irritation in persons of nervous temperament, will sometimes prove sufficient to induce neuralgic affections, which in the commencement may be slight and variable in their seat, occurring sometimes in a tooth or in the face, at other times in an extremity, and recurring under the influence of any cause which depresses the strength or disturbs the stomach, as fatigue, anxiety, fasting, or injudicious diet. The tongue in such cases often presents elevated red papillæ; flatulent distention of the abdomen is apt to occur after food, especially if digestion be interfered with by anxiety or study. These cases require mild and careful treatment. Powerful remedies, whether of the purgative or tonic class, aggravate the local as well as the general irritability, while opiates give only temporary relief, and add the inconvenience of their own effects to the original malady. A considerable proportion of such cases, neglected or violently treated, gradually assume the exquisite form, and become unmanageable; but if, on the contrary, the diet be judiciously regulated, and be nourishing, unstimulating, and taken at regular intervals; if the powers be husbanded, and a due proportion of sleep ensured; if acidity be corrected by small doses of soda or magnesia; and if other symptoms, as they arise, be met with prompt and mild measures, the neuralgic tendency will generally be overcome.

In paroxysms of pain, associated with the condition just described, even after the failure of laudanum, we have known decided relief produced in a few minutes by the administration of two or three grains of carbonate of soda. The impor-

tance of these facts is here peculiarly insisted on, because the habits of medical education are perhaps calculated to engender a bias in favour of the employment of powerful remedies. In the management of acute inflammatory diseases, such a bias may be safe and useful; but in the treatment of nervous affections, which constitute an increasing proportion of the cases which fall under our care, the secret of success will probably be found rather in the accurate adjustment of mild measures, than in the bold adoption of heroic plans. In the instances above referred to, the successive employment of quinine, arsenic, mercury, iron, and other powerful medicines, too often produces an almost incurable condition of the intestinal mucous membrane, while the original disorder remains unmitigated; and the administration of opium for the purpose of temporary relief becoming more frequent and excessive, an alternation of torment and torpor constitutes the remainder of a life, at last terminated by apoplexy, the production of which these measures may accelerate. Doubtless the vacillation of patients impelled by the urgent desire for immediate relief frequently to change their medical attendant, by depriving any one plan of treatment of a fair trial, materially contributes to these lamentable results.

A more confirmed derangement of the digestive organs, attended with depraved hepatic secretion, and a deposit in the urine of the brickish red sediment of purpate of soda, is sometimes connected with neuralgic maladies. There is not necessarily any peculiarity in the nature of the pain in this or any other variety of symptomatic neuralgia, but when depending on chronic disturbance of the digestive organs, the complaint perhaps affects some situations more than others, especially the head, shoulders, and hypochondriac regions, the treatment of these cases resolves itself into the careful adoption of measures adapted to the peculiar form of indigestion. But the occasional use of mercurial pill, followed by a combination of bitters and aperients, will generally prove useful; and when there is much nervous pain of the head, a combination of valerian and iron will sometimes give relief. In other instances, in which the derangement of the digestive organs is more protracted and severe, the urine deposits the white earthy sediment of the triple phosphates, and the general strength is extremely reduced, a complete change of scene and habits will often be found essential. The diet may be as generous as the digestive functions will admit; and wine, though generally inexpedient, will sometimes be desirable. Mr. Carmichael, who suffered severely from this form of the complaint, in the interesting detail of his own case, mentions having derived benefit from the use of the Lafitte and Château Margaux claret. He also had recourse to the baths of St. Sauveur and Barèges, which are well deserving of a trial.* Active exercise must not be ventured on too soon. In cases characterized by torpor rather than irritability of the intestines, a decided impression by means of purgatives will sometimes prove useful. In support of this opinion it may be mentioned, that Sir Charles Bell administered small and repeated doses of croton oil in several obstinate examples of neuralgia with great success. When the disease has been seated in the hip or scrotum, he has frequently observed a scalding sensation of the lower extremities exceedingly like what is often felt during the passage of a purgative through the intestines; and he has always regarded this symptom as a sufficient indication that the source of the complaint is in the bowels.

2. The second division of sympathetic neuralgia, namely, the hysterical, most frequently affects the intercostal nerves, especially on the left side, the hip and thigh, and the inner part of the knee joint. This subject having been already treated of in the article *HYSTERIA*, does not now require a lengthened notice. It will be sufficient to mention that the treatment consists chiefly in the correction of uterine irritation, the improvement of the constitutional condition, and the local

* Some of the effects of the internal use of the Barèges water may be obtained by taking in the morning 60 grains of tartarized soda and 20 of the bicarbonate with 2 of sulphate of iron, in a pint of warm water.—AUTHOR.

application of belladonna or other soothing remedies. In some of these varieties the sesquioxide of iron possesses considerable efficacy, but its use sometimes requires the preliminary application of leeches to subdue local congestion.

3. Rheumatic neuralgia is apt to occur in gouty or rheumatic subjects after exposure to wet; the pain is induced by slight exercise, and is dull, aching, or gnawing, rather than stabbing or plunging. In these instances there is reason to believe that the neurilemma is more or less affected. If the attack be acute, cupping or bleeding will be necessary, followed by the use of antimony, colchicum, and purgatives. Plasters of opium or belladonna may be advantageously applied, and an occasional night dose of calomel combined with James's powder, guaiacum, nitrate of potash, and opium, followed by an aperient in the morning, will sometimes prove singularly efficacious.

If the complaint be decidedly intermittent, quinine will be found almost a specific. In the chronic form, especially if benefited by the application of warmth, the administration of turpentine will sometimes give relief; but the ammoniated tincture of guaiacum, in doses of from twenty drops to two drachms every four hours, is probably the most efficacious remedy. Stimulating applications containing mustard, pepper, or salt, the hot douche, sulphuretted baths, and especially those of St. Sauvier and Barèges, may be had recourse to with advantage. In this form of neuralgia, acupuncture is often surprisingly efficacious. These cases are remarkably influenced by the state of the mind, which must therefore receive a due share of attention.

Neuralgic complaints have occasionally occurred, apparently produced by syphilitic exostosis, and which yielded to mercury. Dr. Corkindale administered this mineral with success in a case in which this origin was suspected. The late Dr. Warren was indeed accustomed to treat most cases of neuralgia with blue pill combined with extract of belladonna; but though the mercurial plan has occasionally succeeded, yet as a general rule it may be stated, that except in instances depending on a syphilitic origin, the continued use of mercury is more likely to increase the nervous irritability than to cure the complaint.

Dr. Rowland mentions having derived great benefit from the application of nitrate of silver to the vesicles in cases of neuralgia depending on herpes. When the complaint is produced by the irritation of old cicatrices, he applies the same remedy to the cicatrix, and also insulates it from the surrounding skin by a circle of the caustic. It is worthy of notice, that when the insulation is incomplete, the pain, although checked in its usual course, shoots through the opening and attacks the neighbouring parts. (*On Neuralgia.*)

In neuralgia of the urethra, the occasional introduction of a bougie constitutes the most effectual treatment. In neuralgia depending on sub-cutaneous tubercle the local application of belladonna often gives considerable relief, but the only effectual remedy is excision. The application of caustic has been tried, but with unsatisfactory results; and the sore produced has proved difficult to heal.

P A R A L Y S I S.

Explanation of the term.—Varieties and distinctions.—Symptoms.—Mode of accession.—Description of the various forms and varieties of paralysis.—General paralysis.—Hemiplegia.—Paraplegia.—Various forms of local paralysis.—Paralysis of particular muscles.—Strabismus.—Ptosis and lagophthalmia.—Aphonia.—Paralysis of the face.—Paralysis of a limb, or particular muscles of a limb.—Paralysis of sensibility.—Amaurosis.—Cophosis.—Anosmia.—Ageusia.—Anæsthesia.—Paralysis of motion.—Paralysis of the insane.—Paralysis from metallic poison.—Mercurial palsy.—Lead palsy.—Paralysis agitans.—Causes of paralysis.—Anatomical characters.—Nature.—Crossed effect from lesions above the medulla oblongata.—Direct effect from lesions below.—Diagnosis.—Seat of the lesion.—Nature of the lesion.—Prognosis.—Treatment.

By paralysis (from *παράλυσις*, *dissolutio*, *resolutio*) is understood a diminution or loss of motion and sensibility in one or more parts of the body. By the older writers it was confounded with apoplexy, with which it is often complicated, but they are quite distinct and independent of each other.

Varieties and distinctions. It unusually happens that both motion and sensibility are affected together; but the one may be lost or diminished, while the other is unimpaired. Hence the necessity of distinguishing paralysis of motion from paralysis of sensibility. The former is called *acinesia* (from *ακίνησις*,) the latter *anæsthesia*, (from *ἀναίσθησις*.) All paralytic affections, then may be divided into two classes:—the first including those in which both motion and sensibility are affected; the second those in which the one or the other only is lost or diminished. We propose to denominate the former *perfect*, and the latter *imperfect* paralysis. Again, the paralysis may be *general* or *partial*, as it affects the whole body or only a portion of it. Partial paralysis is divided into *hemiplegia*, (from *ἡμισυς*, *dimidius*, and *πληττω*, *percutio*,) when it is limited to the lateral half of the body; and into *paraplegia*, (from *παρὰ* aug., and *πληττω*,) when it is confined to the inferior half of the body. The term *local paralysis* has been applied when a smaller portion of the body, as a limb, a foot, a hand, or a finger, becomes affected. As regards intensity or degree, paralysis may be *complete* or *incomplete*. With respect to its cause, it is spoken of as being *idiopathic*, when arising from mental emotions, exposure to cold, &c.; or *symptomatic*, when occasioned by any other malady. The propriety of using the former term is very doubtful, as every form of paralysis is symptomatic; although in all cases the nature of the morbid lesion on which it depends is not known. When produced by lead, mercury, arsenic, and other poisons, the term *venenata* has been usually adopted. Paralysis may be *fixed* or *moveable*, *continued* or *intermittent*. Some nosologists describe an *exanthematic*, *febrile*, *plethoric*, *serous*, *bilious* paralysis, &c.; but these terms are little used in the present day, being mere designations of causes. When treating of apoplexy, congestive and organic, cephalalgia, myelitis, &c., we have enumerated the symptoms which precede paralysis. We consider it unnecessary, therefore, to say any thing here of premonitory signs.

Paralysis has been observed more frequently on the left than on the right side,

C which has been attributed to the greater weakness of the former, and the comparatively little exercise to which it is subjected. It is also more common in the lower than in the upper extremities. In whatever part of the body paralysis appears, it may be perfect or imperfect, complete or incomplete. Sometimes there is a greater loss of mobility than of sensibility, or the reverse takes place, and every gradation may occur from the most trifling loss of either to the complete abolition of both. When different parts on the same or opposite sides of the body are affected, as the legs, arms, &c., the paralysis may be more complete or perfect in one place than in another. In hemiplegia, the arm or the leg may be most completely paralyzed, and in paraplegia one leg more than the other. In local paralysis also, as of the leg or arm only, an individual may have perfect and complete paralysis in the fingers or hands, toes or feet, while in the fore-arm or leg the paralysis is incomplete or imperfect.

Paralyzed parts present different appearances. They are generally pale, livid, and flaccid; sometimes œdematous. In certain cases they are covered with copious perspiration, which is occasionally of a viscous or greasy nature, and in others, while the perspiration is abundant on all other parts of the body, there is no perceptible moisture in those which are paralyzed. The temperature is sometimes increased, as remarked by Dr. Abercrombie, or it may be diminished, as observed by Mr. Earle and others, a circumstance which the former writer has attributed to their losing the property which healthy parts possess of retaining a medium temperature, while they readily acquire that to which they may be exposed. There is often more or less rigidity of the muscles in paralyzed limbs, and the joints are usually in a state of flexion. Sometimes they can be readily extended, but it is often necessary to overcome more or less resistance in doing this. In old persons, if the disease has existed some time, the joints often become flexed, and almost immoveable. Though in a large proportion of cases, there is impaired motion and sensibility in paralyzed parts, they are occasionally painful, the pain being of a tingling, pricking, dull, acute, or even lancinating character. It may also shift from one paralyzed part to another, and may be continued, remittent, or intermittent. The muscles in such cases often appear to be the seat of this pain, as it is not increased by slight contact, but by pressure.

A peculiar sensibility in paralyzed parts is a subject which has lately attracted some attention. In a case of complete paralysis of the extremities, detailed by Dr. Elliot of Carlisle (*Lancet*, 1837-8, vol. ii. p. 77.) spasmodic actions were occasioned on irritating the parts. We have often seen in limbs which were paralyzed, muscular motions excited by pricking or pinching the skin, and especially by tickling the sole of the foot, although the utmost voluntary efforts of the individual were unable to produce the slightest movement. But in such cases there has always been some slight feeling, and we have never observed these movements when the patient has been wholly unconscious of the application of stimuli to the affected part. We have no doubt, however, that spasmodic actions may be occasioned in paralyzed limbs by the application of stimuli, independent of sensation, although their occurrence in the human subject must be considered one of great rarity.

It has been stated that the circulation in paralyzed is more languid than in healthy limbs, and that the pulsations of the arteries are diminished. Whether this is universally the case may be doubted, but some observations to which we shall presently refer, show that it frequently happens. In a longer or shorter time, paralyzed parts diminish in volume, become thin, and afterwards sensibly atrophied; which is another proof of diminished circulation. It sometimes happens that, while the tissues are really atrophied, a greater or less effusion into the cellular substance may give the part an appearance of enlargement. When one or both of the inferior extremities are affected with incomplete paralysis, so that with the assistance of a stick or crutch the patient is enabled to walk, progression is made in a peculiar manner. This is very well seen when one limb only is affected. In such cases the knee of the paralyzed extremity is flexed, the heel elevated, while the toes, turned outwards, scrape the floor. There is great difficulty in lifting up the limb

and placing it before the other; in doing this, the foot is thrown outwards, and the patient then sets it down with the knee perfectly straight. The difficulty of walking and the above symptoms are increased as the paralysis becomes more complete, and are often alone sufficient to distinguish the paralytic affection.

When chronic paralysis affects the muscular system, and more especially the lower extremities, interfering with the muscular motion, and consequently the proper exercise of the affected parts, the general health is gradually impaired. The skin becomes pale and flaccid, and the muscles soft. In general, the respiratory or digestive organs are little affected, unless the muscles more particularly connected with these functions are paralyzed. Occasionally, however, the appetite is increased, which sometimes leads the patient into various excesses. The circulation also is usually undisturbed, though palpitations of the heart, and a frequent, feeble, or irregular pulse are now and then observed. The nutritive functions are imperfectly formed: hence, most persons labouring under paralysis, becomes thin. The intelligence is sometimes unaffected to the last, though frequently it is impaired; and the memory is more or less enfeebled. The speech is often thick and confused, and occasionally particular words or names cannot be remembered, or one word is substituted for another. Some paralytics become gradually idiotic, others have their natural character totally changed, and become timid and suspicious, or peevish, irritable, and irascible: mild and placid persons show signs of antipathy, or break out in paroxysms of anger; in other instances, individuals who were previously noted for courage and vigour of mind, shed tears from the most trifling causes, and often without any apparent motive. In the advanced stage of paralysis, but more especially when the mental powers have suffered, the countenance very frequently assumes an expression of stupidity.

The manner in which paralysis comes on is important, with respect to proper views of treatment. The principal points to be observed are, whether it occur suddenly or gradually, with or without premonitory symptoms, as a knowledge of these circumstances is necessary to enable the practitioner to form a correct diagnosis of the morbid lesion which is the primary cause of the disease. Paralysis may take place suddenly from cerebral or spinal apoplexy, in which case all the phenomena we have detailed in describing those diseases are observed. A local form of palsy may be suddenly induced by strong pressure on a limb or a single nerve, by a tight ligature, a fracture, luxation, circumscribed effusions of blood, or various kinds of wounds, dividing the nerves, &c.

Paralysis of one or more parts of the body may occur in various ways. The patient may suddenly and unexpectedly become hemiplegic or paraplegic, or affected with some form of local paralysis at first, in a very trifling degree. There may be only weakness in the part, sometimes accompanied or succeeded by tingling, or a degree of numbness and impaired motion. The individual cannot perhaps stand or walk so firmly as before, or there is an awkwardness in moving one hand, or objects are less firmly grasped by it than by the other. On touching bodies he cannot feel distinctly by means of the hand affected, the sensation produced being often compared to that felt by examining substances with the hand covered with a leather glove. The obscure sensibility and difficulty of movement may remain stationary for some time, and then gradually or perhaps suddenly increase, until complete paralysis is manifested.

In some cases the numbness first appears in a small circumscribed part, as in one toe or finger, and gradually extends up the limbs, often involving in its progress other parts of the body; it may thus commence in the eyelid; spread over one or both sides of the face, and thus suddenly appear in the fingers, arms, toes, or legs. This is denominated by many writers *creeping palsy*. In this manner local or general paralysis, hemiplegia, or paraplegia, may be permanently produced according to the extent to which this creeping affection may proceed. Again, local paralysis has often been caused by the gradual increase of tumours, which press on particular nerves. Lastly, a few cases have occurred in which

the upper parts of the arms have been paralyzed, while the hand was unaffected. (Velpeau, *Arch. Gén. de Méd.*, 1835; Abercrombie, *on the brain*, &c.)

1. *General paralysis*, properly so called, or total loss of sensibility and motion throughout the system, cannot take place without extinction of life. This term, therefore, is only applied to paralysis of the four extremities, whether any other parts of the body are affected or not. General paralysis, like the other forms, may come on suddenly, or gradually. In the former case it is either the result of extensive extravasation of blood, or dislocation and fracture of the bones pressing on the cranial or cervical portions of the spinal cord. When it occurs gradually, it usually commences in the toes or fingers, and extends by degrees over the body. In middle-aged or old persons labouring under this form of the disease, the change in their natural disposition is often well-marked. The intelligence also in general becomes sooner or later impaired. We saw lately an old woman affected with general paralysis, and unable to utter a word or make the slightest sign, betray no indication of intelligence, except by excessive weeping when she was asked questions or even looked at. In this form of palsy loss of motion is usually more marked than that of sensibility, indeed it is very rare that in general paralysis the sense of feeling is entirely abolished. M. Defermon has given a case in which the intelligence was perfect, but the sensibility was wholly destroyed, except in a small patch on the right cheek, by tracing letters on which his friends were enabled to hold intercourse with him. The motion also of every part of the body was lost, with the exception of the muscular apparatus of the tongue, and of the organs of deglutition and respiration. (*Bulletin des Sciences Méd.*, vol. xiii. p. 6.) Another remarkable case is given by Mr. Davies Gilbert, of a girl who had lived to the age of seventeen years without general sensibility or voluntary motion. She was blind, deaf and dumb, and betrayed no evidence of intelligence, except such as was manifested by a feeble cry when she wanted food, and a certain appearance of satisfaction while she was eating fruits and confectionary. On a post mortem examination of this case, the tensorium and dura mater lining the base of the cranium were deficient, the latter being replaced by a thin semi-transparent membrane very lax and irregular. All the nerves were firm and healthy. The paralysis in this case must be ascribed to the pressure to which the nerves were subjected from the mass of the brain before they entered their separate foramina. (*Edin. Med. and Surg. Journ.*, Jan. 1828.)

2. *Hemiplegia*. This term is used to denote paralysis of one side of the body, or at least of one upper and lower extremity. When the arm of one side and the leg of the other is affected, the term *transverse* paralysis was applied by Sauvages. Hemiplegia is the most frequent form of palsy, and has been more commonly observed on the left than on the right side. It is often limited exactly to one half of the body, the median line forming the boundary between the sound and affected side. With a view of explaining this, Bordeu and Bichat supposed that the two halves of the human body were endowed with a separate existence, and possessed a life peculiar to each. The regular distribution of the spinal nerves, however, offers the true explanation. Hemiplegia may come on suddenly without any previous indisposition, or it may be preceded by several of the premonitory symptoms before alluded to, as cephalalgia, twitchings of the muscles, more or less fever, &c. In the former case it often precedes an apoplectic seizure, and on the other hand frequently follows that disease. Indeed, the morbid lesions in the brain, which produce apoplexy, most frequently occasion also hemiplegia, which becomes well-marked on the return of consciousness, and is more or less permanent. Sometimes hemiplegia comes on gradually; local paralysis is perhaps first manifested in the toes, foot, leg, fingers or hand, which slowly extends until the lateral half of the body is affected. More frequently, however, it appears suddenly and unexpectedly, so that very often individuals enjoying perfect health, and performing their usual avocations, are struck with complete paralysis of one side of the body. Occasionally there are spasms in the affected side, from which circumstance the disease has been denominated by

Sauvages *spasmodic*, by other nosologists *hysterical* hemiplegia. It is generally only a modification of hysteria. In incomplete hemiplegia, the gait of the patient has in a remarkable degree the peculiar characters before described, and the arm of the affected side is usually drawn to the trunk, the fingers, arm, and forearm being more or less rigid and in the state of flexion. *Intermittent* hemiplegia has been seen by Sauvages, Torti, Morgagni, Cullen, Larrey, Elliotson, and others. In general it is one of the anomalous forms of intermittent fever.

3. *Paraplegia* has been differently defined by different writers. Hippocrates confounded it with apoplexy. Aretæus understood by it partial paralysis; Boerhaave and Van Swieten, palsy of all parts of the body below the neck. Mr. Earle proposed, as a definition of paraplegia, "a paralytic affection of both sides of the body, whether that be partial or general, in opposition to hemiplegia, in which the affection is confined to one side." The majority of writers, however, have used this term to express paralysis of the inferior half of the body, or at least of the two lower extremities, in which sense we shall employ it.

Paraplegia may commence in the same manner as other forms of palsy, but most frequently begins with weakness and numbness of the inferior extremities, sense of weight and slight pain in the feet, extending a greater or less distance up the legs. The patient has a tendency to trip on slight occasions, and complains of fatigue after little exertion. As the disease advances, the necessity for support increases, until at length the power of walking is lost. Sooner or later paralysis of the bladder and rectum supervenes, occasioning incontinence of the fæces and urine, though sometimes at first there is retention of the latter, which after a time is discharged involuntarily. In paraplegia, the urine is particularly liable to deposit calculous formations, as pointed out by Dupuytren, who observed catheters left in the bladders of paraplegics become quickly covered with calculous incrustation. Sometimes the paraplegia is accompanied with cerebral symptoms, as cephalalgia, vertigo, dimness of sight, diminution or complete loss of the special senses, &c.; in other cases there are evidences of spinal irritation or disease, evinced by tenderness on pressing or percussing one or more of the vertebræ, pain on stooping, alteration of the form of the spine, projection of one or more of the vertebræ, &c. Not unfrequently there is much flatulency of the bowels. When this form of palsy is complete, there is perfect loss of sensibility and motion in the lower extremities, with paralysis of the bladder and rectum, so that the individual is obliged to remain in the horizontal posture; sloughs are particularly liable to form on the sacrum, and the exhausting discharge which follows generally accelerates the patient's death. Brachet of Lyons observed, that in these cases the uterus lost the power of contracting, and that it was always necessary to deliver paraplegic pregnant women with the forceps, a statement however denied by Andral, who has seen natural labour occur in a case of complete paraplegia. When paraplegia is not of very long standing, we find, as in hemiplegia, occasional spasms in the muscles of the lower limbs. Sometimes there is more or less permanent rigidity and contraction of the flexor muscles, so that the extremities are bent; occasionally the extensors have been at the same time similarly affected, and thus the limbs have been kept extended. Dr. Todd alludes to a case in which the extensor muscles were spasmodically contracted; there was no power of flexing the lower limbs, but if at the request of the patient they were placed in the state of flexion after the lapse of a short interval, they were, by short and successive twitchings of the extensor muscles, gradually brought back to the state of extension. (*Cyc. of Pract. Med.*, art. PARALYSIS.) In old chronic cases the muscles become atrophied, and the joints rigid.

4. *Local paralysis* implies loss of motion, and sensibility in some part of the body of small extent; and although frequently only the commencement of a more general affection, it is sometimes permanent: when thus limited it constitutes a modification of palsy.

Paralysis of particular muscles generally arises from division of, or pressure on, the nerves, which are distributed to them. Thus dislocation of the head of

the humerus pressing on the circumflex nerve produces palsy of the deltoid. The serratus magnus anticus muscle may be paralyzed by injury of, or pressure on, the posterior thoracic nerve, as in cases recorded by Gendrin and by Velpeau. (*Anat. Chir.* vol. i. p. 303.) Dr. Stokes has pointed out probable paralysis of the intercostal muscles and diaphragm, in connexion with hydro-thorax and diseased liver. (*Dub. Journ.*, No. xxv.) The sterno-mastoid muscle also may be affected, giving rise to symptoms like those of wry neck.

Strabismus is occasioned by palsy of one or more muscles of the eyeball. Palsy of the eyelids occasions two paralytic affections, *ptosis* and *lagophthalmia*; which are treated of at great length in works on ophthalmic surgery. In the former, the eyelids are partially or completely closed, in the latter they are kept permanently open. The muscles concerned in the act of deglutition are occasionally paralyzed, as in a case related by Mr. Hunter. (*Trans. of Soc. for the Improv. of Med. Knowl.*, vol. i.) But it is a very rare affection, except in hysteria, in which disease dysphagia is occasionally observed. (See *HYSTERIA*.) Dupuytren has given a case in which an hydatid pressing on the ninth nerve caused paralysis and atrophy of one side of the tongue. (*Leçons Orales*.)

Aphonia may be caused in three ways; by paralysis of the muscles of the larynx, of those of the face, or of the tongue. When the muscles of the face are paralyzed, the individual can speak by supporting the cheeks with the hands. The power over the motion of the tongue may be lost for a time only, and afterwards suddenly return. Sometimes certain movements only are abolished or performed with difficulty, while in other respects the actions are natural. In incomplete paralysis of the tongue, when protruded from the mouth it is sometimes straight, sometimes drawn towards the sound, in other cases towards the paralyzed side. Various explanations of the latter occurrence have been given. Lallemand ascribes it to the action of the genio-glossus muscle of the unaffected side drawing the base of the tongue forwards, and turning the apex towards the opposite side. Others attribute it to the stylo-glossus bringing the base towards its own side, and turning the apex towards the opposite, by a swivel kind of movement. Cruveilhier considers, that, when the tongue is thrust forward, it inclines towards that side on which there is the most feeble resistance.

The above forms of partial paralysis rarely occur by themselves, and are more generally met with when one side of the body or face is affected.

Paralysis of the face. This form of paralysis is the effect of pressure or injury of the portio dura and fifth pair of nerves. In perfect paralysis of the face, the loss of motion is produced by lesions of the portio dura and motor branch of the fifth, and loss of sensibility by lesions of the sensitive portions of the latter nerve. The symptoms vary according as one or other of these is more immediately affected.

If the fifth nerve only is the seat of disease, in addition to more or less loss of sensibility of the parts which its branches are distributed, the motions of the jaw on the affected side are impaired. Mastication is impeded in consequence of palsy of those muscles which subject the morsel to the action of the teeth; and from the impaired grinding motion of the jaws, the individual can only chew on the sound side, while in performing this act the action of the masseter and temporal muscles of the affected side is more or less imperfect. There is still command over the features, however, and no distortion of the countenance, or loss of expression. The jaw is in some cases a little depressed, but this almost disappears when the patient smiles or laughs. This form of paralysis may exist alone, but is usually combined with hemiplegia. The loss of sensibility is referrible to a morbid condition of the ganglionic division of the fifth, and loss of mobility to the non-ganglionic portion. It is very rare that one is affected without the other. M. Serres has recorded a case where the gasserian ganglion only was diseased, occasioning loss of general sensibility on one side of the face, without impairment of mobility. (*Arch. Gén. de Méd.*, tom. v. p. 629.)

When the portio dura is affected, the general sensibility remains intact, while

the muscles of the face to which its branches are distributed are paralyzed. The aspect of the face differs according as the muscles are in a state of repose or activity. In the former case, all expression is lost in the paralyzed part; the two sides of the face are not symmetrical, and when viewed by themselves, apparently belong to different individuals. The features generally are dragged towards the sound side; the labial commissure of the paralyzed part is drawn rather downwards, and is brought nearer the median line; the mouth is oblique, and its centre does not correspond to the axis of the body. The paralyzed half of the face is a little more prominent than the sound one, which is wrinkled, contracted, and concealed behind the other, when viewed in profile. The paralyzed side also appears broader than the sound one, while the eyelids are opened wide, and the eye appears more voluminous than its fellow. When, on the other hand, the individual speaks, laughs, cries, sneezes, or coughs, the deformity of the countenance is much increased, the mouth and features remaining perfectly motionless on the paralyzed side, while on the other they appear thrown into inordinate action. The muscles moving the jaws, however, which are supplied by the motor portion of the fifth, are still obedient to volition; mastication is readily performed, and the patient can hold solid bodies between the teeth. The cheek on the affected side is flaccid, it swells at the moment of expiration, and especially when the patient wishes to blow or pronounce a word with emphasis. The lips are paralyzed, and the saliva and aliments sometimes escape from the mouth on the palsied side. The pronunciation of the vowels, as the *o* for example, which requires the intervention of the lips, is imperfect. The labial consonants, as *b* and *p*, are very imperfectly articulated. Lastly, the patient has difficulty in spitting out his saliva, or directing it to any given point at a distance from his mouth. Occasionally the patient is enabled to articulate with tolerable freedom, by supporting the paralyzed cheek with his hand. Lagophthalmia is frequently observed in this variety of palsy, exposing the eye to constant irritation, and often producing ophthalmia. When the disease is of long standing the affected muscles are often wasted, giving a peculiar expression to the countenance, which an experienced eye readily recognises.

It is rare that the lesions are confined to the fifth or seventh pair of nerves; in general, the symptoms characterizing disease of the one and the other are conjoined, although both nerves are seldom equally affected. It usually happens that the affection appears first in the one and then in the other, and that when the muscles on which the nerves of the first ramify are completely paralyzed, the muscles supplied by the second are partially affected. In these cases also the paralysis is often accompanied with neuralgia of a very distressing and acute description. We have lately seen a case of paralysis of the left side of the face, in which the eyebrows, chin, and all the parts furnished by the first and third branches of the fifth nerve, were completely paralyzed and perfectly insensible, while the cheek, left ala of the nose, and parts supplied by the second branch, were extremely painful, and the slightest touch caused intense agony.

Paralysis of a limb, or of particular muscles of a limb, is not uncommon, arising from causes affecting the nerves by which it is supplied. Dr. Healy has described it appearing suddenly in the hand and fore-arm, during sleep, which he attributes to the head resting on the arm, and compressing the nerves. (*Dub. Hosp. Rep.*) Dr. Darwall has seen paralysis of the deltoid muscles attached to the scapula and humerus follow the lifting of heavy weights. It often extends to the whole extremity, and apparently arises from the nerves being injured by the exertion and straining employed. Sometimes the extensors, in other instances the flexors only, are affected. Occasionally, as noticed by Sir C. Bell, there is only paralysis of the fingers, so that the power of writing is either lost, or the letters are written zigzag. In the same way, by injuries or diseases of the different nervous branches, the muscles, or sets of muscles they supply in either of the extremities may become paralyzed. In general, however, when palsy occurs in the hands or feet, it is the precursor of mere general paralysis.

5. *Paralysis of sensibility*, both special and general, may occur, the muscular motion being perfect or only impaired.

Amaurosis. The disease is termed amaurosis (from *αμαυρος*, obscure,) when the retina loses its sensibility to the rays of light. We must refer to AMAUROSIS and to works on ophthalmic surgery for a description of this affection, as our limits preclude us from treating so important a subject in this place.

Cophosis (from *χωφός*, deaf,) is used to express deafness, or insensibility to the impressions of sounds. It may be caused by compression or structural disease of the auditory nerve; obliteration or obstruction of the canals and passages of the auditory, apparatus, &c.

Anosmia (from *α*, privative, and *οσμή*, smell,) or insensibility to odours, is sometimes congenital. Cases of this kind have been met with by Good, Todd, Presat (*Thèse*, 1837,) and others. When it is the result of disease, it is occasioned by pressure on, or organic alterations of, the brain, involving the olfactory nerves and ethmoid bone. More commonly it follows alterations in the Schneiderian membrane, of an inflammatory or congestive nature, as in coryza.

Ageusia (from *α* privative, and *γευστός*, taste,) or loss of taste, is occasioned by insensibility of the nerve or nerves, which have been termed gustatory; but what those nervous branches so endowed really are, is a point still disputed by physiologists. Chewing tobacco or other narcotics, smoking, a thick fur on the tongue, as in the various forms of acute as well as chronic diseases, may more or less impede or destroy the taste.

Anæsthesia (from *α* privative, and *αἰσθησις*, sensibility.) In perfect paralysis there is loss of general sensibility, or that of touch, as well as loss of motion. But when the sensibility is lost or diminished, while motion remains perfect or nearly so, the affection is denominated anæsthesia. This may be complete or incomplete, general or partial. Good, Yellowly, Earle, Bell, Andral, Ollivier, and others, have recorded cases of complete anæsthesia. In these instances the part affected is insensible to the most powerful stimuli, or to the most severe injuries. Phlegmonous abscesses, the formation of blisters from the application of heat, wounds of different kinds, fractures, &c., have occurred without causing the slightest pain. Mr. Liston removed the metatarsal bone of the little toe from a gentleman who did not experience the slightest pain during the operation; sensibility was nearly if not altogether lost, while that of motion was so entire as to enable him to use his hands in carving his food, in writing, holding the reins on horseback, &c. (*Med. and Surg. Journ.*, vol. xxxi. p. 292.) A similar case is related by Mr. Reid. (*Idem*, April, 1829.) Such cases, however, are very rare. A singular case is recorded (*Med. Chir. Trans.*, vol. ii. p. 217,) in which the left side of the head was insensible, while the sensibility of the right was perfect; in the left side of the body, and in the left extremities, also, the sensibility was diminished. The right side was quite insensible to touch, but the impressions of heat and cold produced sensations directly opposite to those experienced in health. Instances are recorded in which, although the anæsthesia was general, a small spot on the surface retained its sensibility. In a case related by Ollivier, this spot was situated on the hip, and in another, by Andral, on the cheek. In general, however, the disorder is partial. Andral has observed the loss of sensibility confined to five or six round spots on the surface, of the size of a crown-piece, the surrounding skin being perfectly natural. (*Clin. Med.*) It may also be limited to different parts of the face, to a limb, one side of the body, &c. Muscular motions, under such circumstances, can apparently only be performed by the individual fixing all the attention he can command on the performance of the required muscular effort. In Dr. Yellowly's case the patient could hold objects so long as her eyes were directed to them; but the moment her attention was otherwise directed, they fell from her grasp. When the face is so affected with anæsthesia, that a portion of the lips only is involved, the individual on drinking from any vessel invariably feels as if the margin was broken. It has been observed,

that the mucous membranes continuous with the common integuments affected, not unfrequently lose more or less of the general or special sensibility, with which they are in their healthy state endowed. Hence the conjunctiva becomes insensible and inflamed, the inflammation in some cases being so severe as to destroy vision, from the application of irritating bodies of which the patient is unconscious. The Schneiderian membrane is sometimes similarly affected, and the sense of smell destroyed. Occasionally there is deafness, and in many cases loss of taste results from the want of general sensibility in the mouth. In the same manner when anæsthesia attacks the abdomen and lower extremities, the introduction of a catheter into the urethra causes no pain, and the urine flows from the bladder, and fæces from the rectum, without the consciousness of the individual.

Anæsthesia may come on suddenly or gradually. In the latter case there is sometimes a sensation, as if fine sand were interposed between the skin and the object touched, or as if the former were covered with woollen or other kinds of stuff, or it sometimes commences with pricking or formication. In either case the insensibility may remain stationary for an uncertain period, and then disappear, or gradually increase, until complete anæsthesia is produced.

The duration of this affection is variable. It may continue for a short period only, or for several years: in the former case it may return unexpectedly. M. Guest has given an account of the disease as it appeared epidemically in Paris, in the summer and autumn of 1828. (*Arch. Gén. de Méd.*, October, 1828.)

6. *Paralysis of motion* generally accompanies loss of sensibility, but may occur without the sensibility being at all impaired. We are not aware of any recorded case, however, in which the voluntary motion was completely abolished, while the sensibility in the motionless part was perfect. Dr. Ley has described the case of a young woman, who after delivery became affected with loss of motion on one side of the body, and loss of sensibility on the other. She would hold the child to one breast as long as she looked at it, but on the attention being abstracted, there was danger of her dropping the infant. On this side she could not feel the application of the child's mouth to the nipple, though she could see it sucking; on the other side feeling was intense, but she was unable to hold the child to the breast. A somewhat similar case is given by Dr. Bright. (*Case 271.*) Not unfrequently paralysis of motion alone is a sequel of perfect paralysis, the sensibility gradually returns, having the power of motion more or less affected.

The accession of paralysis of motion may be sudden or gradual. Sometimes a certain degree of rigidity is present in the paralyzed part, and the limbs are somewhat flexed; in other cases they are perfectly flaccid and powerless. Loss of motion is occasionally preceded by spasms and pain, more or less violent and severe; and not unfrequently the sensibility is morbidly increased. Mr. Travers relates the case of a man who, after an injury of the back by a fall, felt the most agonizing pain in the lower extremities from the slightest touch: to use his own words, "when any one even walks by his bed-side, it is just as if a number of razors were cutting him down to the bone." (*A farther Inquiry into Constitutional Irritation*, pp. 358, 359.) Dr. Abercrombie also relates a case in which, conjoined with loss of motion in the arm, the sensibility was so increased, that the least breath of cold air brought on convulsions. The sensibility of the part also may be more or less perverted, giving rise to sensations of pricking, tingling, or formication; hot bodies may be mistaken for cold, or cold bodies for hot.

7. A peculiar form of paralysis occurs in the alienated, which has been described with great care by Calmeil (*De la Paralyse considérée chez les Aliénés.*) and also by Dr. Prichard (*Treatise on Insanity.*) It may precede insanity, a circumstance, however, which is very rare, or take place at the same time, which is not common, or, as is generally the case, it may appear at a longer or shorter interval after alienation has been established. It is a kind of creeping palsy, but

presents the peculiarity of appearing first in the tongue.* The whole course of the affection has been divided into three stages. In the first the movements of the tongue are embarrassed, and this increases until the pronunciation of words, which is at first difficult and performed with effort, becomes impossible. In the second stage the paralysis extends to the extremities, most commonly the inferior commencing by a degree of weakness, dragging of one limb, &c., and gradually increases in intensity, and at the same time extends to the superior extremities and other parts of the body. In some the paralysis is permanent, but in others motion has been known to return under the influence of passion, or strong mental emotions. When all power of locomotion has ceased, the third stage is established, and the disease then gradually affects the functions of organic life. The bladder and sphincter ani are paralyzed, and if the affection is not complicated with other organic lesions, which may terminate life, the individual dies from general exhaustion, palsy of the muscles of deglutition, or those of respiration, producing asphyxia. The sensibility is very slightly affected in this form of paralysis.

The paralysis of the alienated now described is very common in Paris, and has been observed more so at Charenton, where patients in an elevated class of society are treated, than at the Bicêtre, which is an institution for the poor. It is most frequent between the ages of thirty-two and fifty, being rare before and after that period. It is seldom that an insane person with paralysis lives more than four or five years; but Calmeil says, that "such individuals have the chance of existing for thirteen years."

8. Paralysis from *metallic poisons* presents peculiarities that require notice.

Mercurial palsy. This form of paralysis is liable to attack artificers in quicksilver, gilders of toys, buttons, glass-platers, barometer-makers, &c. It generally comes on gradually, although in some cases its appearance is sudden. The arms are the parts generally first affected, and the individual has less control over them than usual. Sometimes he experiences a sense of weakness; occasionally slight convulsive twitchings, followed by a continued state of tremor, which gradually extends to the legs, and, in some cases, to the whole body. All muscular movement is now so impaired, that any kind of combined motion is imperfectly performed. Thus articulation, mastication, and locomotion, are performed with difficulty, and the use of the hands is almost entirely lost. Occasionally the muscular movements are so violent as to resemble convulsions. In some cases the patient suffers from abdominal pains; the whole body has a brown tint, the skin is dry; there is restlessness and delirium, with more or less derangement of the general health. There is no disorder of the respiration, impaired digestion, or colic; and, except in chronic cases, no wasting. Mental emotions and efforts to control the muscles almost invariably increase the inability and tremors.

Lead palsy. Plumbers, glaziers, painters in oil and water-colours, type-founders, colour-grinders, and workers in the different preparations of this metal necessary for manufactures and the arts, are liable to be affected with palsy. It usually accompanies or follows colica pictonum, but may exist independently of that affection. It has been rarely observed in the inferior extremities, the hands being generally affected, though the palsy sometimes extends to the fore-arm. Lead palsy commences by a feeling of weakness in the fingers, which soon extends to the wrists, beyond which it seldom passes, although there is often pain in the shoulders, arms, and fore-arms; which resemble rheumatism. The wrist, according to Dr. Pemberton, is remarkably flaccid and loose. The patient cannot grasp any thing with firmness, and, as the disease advances, he cannot use the hands. The fingers are bent, and cannot be extended voluntarily; there is no rigidity, however, as they can readily be straightened by force, and assume their

* Sometimes in the lower extremities; but at first it requires a good deal of experience to detect it.

natural position when the arms hang down.* In general there is little diminution of sensibility in the skin. Christison and Bright have noticed the occasional wasting of the paralyzed parts.

Paralysis from arsenic, given in poisonous doses, has been observed by De Haen, Murray, Falconer, Christison, and others. It generally occurs in the extremities, and may be complete or incomplete. Dr. Christison observes, "on the whole, local palsy appears to be the most frequent of the secondary effects of arsenic." (*Treatise on Poisons*, 3d edit. p. 184.)

9. *Paralysis agitans*. A peculiar form of palsy, termed *paralysis agitans*, has been minutely described by Mr. Parkinson. Its approach is very gradual, and characterized by weakness and trembling, which usually commences in the hands and arms, but occasionally in the head, and by slow degrees extends over the whole body. At length the trembling becomes incessant, and when the patient attempts to advance, "he is thrown on the toes and fore part of the feet, and impelled unwillingly to adopt a running pace, being in danger of falling on his face at every step." When the disease is advanced, the shaking continues during sleep; the patient cannot carry food to the mouth; there is constipation; mastication and deglutition are performed with difficulty; the agitation at length becomes so violent as to prevent sleep; the body is bent forward, and the chin bent upon the sternum; articulation is impaired or entirely lost; the urine and fæces pass involuntarily; and "coma, with slight delirium, closes the scene." (*Parkinson on the Shaking Palsy*.) This affection, which is rare, is distinguished from mercurial palsy, delirium tremens, chorea, and nervous tremor, by the agitation continuing when the limb is supported, and the peculiar gait of the patient—a symptom which has been thought by some, pathognomonic.

Causes. Paralysis is more common in men than in women, and less frequent in youth than in infancy and adult age. It is one of the most frequent disorders of old persons. It is much oftener observed in persons of a feeble constitution, and in those who lead a sedentary life; while those of the sanguinous and nervous temperaments are said to be more predisposed to the affection than others. Particular trades favour the production of certain forms of paralysis; thus, as we have noticed, the disease occasionally occurs in house-painters, plumbers, workers in the different preparations of lead, glaziers of earthenware, miners, ornamental and water-colour painters, looking-glass and barometer-makers, &c. From the appendix attached to Dr. Cook's work, palsy appears to be rare among soldiers. Mental labour and luxurious habits of living also predispose to paralysis, much more than a sober and active life, or one requiring much exercise in the open air.

The *exciting* causes may be divided into, 1. Those which affect the brain or spinal cord; and, 2. Those which influence the nerves in their course, or at their extremities.

1. The causes which more particularly influence the brain and spinal cord are those which produce pressure on, or destruction of, the nervous matter. Hence blows, falls, fractures, or other injuries affecting the skull and vertebral column, occasioning either concussion or depression of bone; osseous, fibrous, encephaloid, hydatid, tuberculous, or other tumours pressing on the nervous mass, or disorganizing its substance; alterations of the bones and ligaments of the spine by caries, scrofula, or rachitis; atrophy, or agenesis, of the nervous centres; inflammation of the brain, and its consequences, as suppuration, softening, induration, &c., and indeed every kind of lesion to which the brain and spinal cord are liable, are exciting causes of paralysis. Any circumstance producing congestion, whether arterial or venous, may induce paralysis,—as the various mental emotions, joy, anger, grief, terror, anxiety, &c., exposure to cold or heat, sudden changes in the temperature of the weather, intemperance, fatiguing occupations and

* The peculiarity of this form is that the extensors are much more affected than the flexor muscles. The latter remain strong for a long time after the patient is completely unable to straighten the hand.

strained positions, constipation and affections of the bowels, metastasis of gout or rheumatism, diseases of the heart, sudden disappearance of the eruptive fevers, suppression of the lochia or menstrual discharge, cicatrization of old ulcers, sudden check to the perspiration or accustomed discharges, as the hæmorrhoidal, epistaxis, &c., excessive venereal indulgences, &c. Paralysis has also been known to follow tying the carotid artery.

2. The causes which act especially on the nerves are, inflammation and thickening of the different membranes at the point where they leave the cranium, or vertebral canal; disease of their investing neurilemma, or of the nerves themselves; various tumours situated in their course, in which they may be involved, as aneurisms, osseous, fibrous, encysted, and other kinds of morbid growths, abscesses, effusions of blood, contusions, &c.; fractures or spiculæ of bone, or luxations producing pressure on one or more of the nerves; various kinds of wounds or incisions by which they are divided; ligatures thrown round them in tying an artery, &c. Paralysis may result from exposure of a part of the surface to a piercing wind, or to cold, from the influence of this agent on the extremities of the nerves of the part.

Some causes act in an obscure manner; thus the influence of metallic poisons, as lead, mercury, and arsenic, in producing palsy, has not been explained. Paralysis has followed the inhalation of certain fumes. Stoll says he has seen hemiplegia produced by the fumes of charcoal, (*Rat. Med.* p. 7,) and Bosquillon by the vapours of quicklime and mephitic air.

Anatomical characters. Every kind of alteration to which the nervous system is liable, has at different times been found on the dissection of persons who have died paralytic. On the other hand, many cases, both of local and general paralysis, have been examined after death, without any morbid lesion whatever having been discovered. To enter into the morbid anatomy of paralysis, however, is only to repeat what has been stated, when describing the diseases of which it is symptomatic. Thus the membranes and substance of the brain have been found more or less vascular, presenting traces of acute or chronic inflammation, or extravasations of blood, effusion of serum, softening, induration, abscesses, ulcerations, different kinds of tumours, apoplectic cysts, &c. (See INFLAMMATION OF THE BRAIN, APOPLEXY, &c.) It has been observed also to follow an imperfect development, or "agenesia," of the nervous centres, and wasting or atrophy of the same parts. We have often seen the corpora striata atrophied in old persons, in whom no other morbid alterations could be discovered, and are inclined to think that this is a more common lesion in old paralytics than is generally supposed. In a case of hemiplegia, mentioned by Mr. O'Halloran, a considerable quantity of the right hemisphere had sloughed out, producing a "frightful cavern." (*Injuries of the Head.*) The membranes and substance of the spinal cord have been found to present all the appearances described under EPILEPSY, SPINAL MENINGITIS, MYELITIS, HYDRORACHIS, and SPINAL APOPLEXY. Caries of the vertebræ, as described by Pott, is sometimes found, and more or less displacement of the bones, from relaxation of the ligaments.

The nerves have been discovered more or less injected, and of a deep-red or violet colour. They have been found occasionally enlarged by Pinel, Rostan, and Cazauvielh, but are more generally atrophied. They have also been disorganized by suppuration, softening, and complication with various morbid growths. Sometimes the nervous tissue has been indurated, and in a few cases has totally disappeared, leaving the sheath filled with fluid. The sheath may be thickened, causing more or less pressure on the nerve it encloses. A knowledge of the alterations occasionally discovered in the nerves, is only to be obtained by studying individually the numerous cases recorded by different authors, to whose works we must refer, especially to those of Bell, Abercrombie, Shaw, and others.

Changes of structures in other parts of the body have been found, but such alterations are for the most part accidental. Inflammation and thickening of the membranes of the brain and spinal cord, which are not unfrequent, are capable

of explaining numerous cases of paralysis. Changes in the blood-vessels also have been thought capable of producing local paralysis, as in cases related by Abercrombie, Rostan, Storey, Graves, Stokes, and others. In these there was more or less disease of the vessels leading to the part, ossification of their coats and obstruction of their calibre from coagula of blood. Andral mentions the case of a child who was subject to momentary paralysis of the voluntary muscles, in whom the superior longitudinal sinus was transformed into a hard cord, and the veins entering into it filled with coagulated blood. The muscles of paralyzed limbs have sometimes been found degenerated into fat, especially in scorbutic individuals.

Nature. If some parts of the nervous system be the origin of nervous power, while others serve to conduct it, paralysis may be induced by any circumstances which diminish or prevent its evolution or transmission. Disease in the gray matter of the spinal cord may destroy the first, and injury of the medullary matter, or nerves, the second property; and the extent of the paralysis will be greater or less, according as the morbid lesion involves the origin of a greater or less number of nerves, or, what amounts to the same thing, cuts off their intercourse with the brain. Hence congestion, inflammation and its results, or the different kinds of morbid growths, may occasion paralysis by pressing upon the nervous mass, so as to prevent the exercise of its proper functions; or the same result may be produced by degeneration and destruction of the nervous tissue, cutting off its communication with the brain, the source of volition. Under the head of **APOPLEXY** we have explained how pressure or disorganization, when they occur in the brain and cranial portion of the spinal cord, may cause paralysis; and, when speaking of spinal irritation, we have alluded to the influence of congestion on the vertebral portion, in which also morbid growths, and other changes of structure will necessarily interfere with its functions. In order, however, to understand the pathology of paralysis, it will be necessary to give an outline of the different laws by which the cranial and vertebral portions of the cord appear to be governed.

It has long been a matter of observation, that disease on one side of the brain causes paralysis on the opposite side of the body—an effect which modern pathologists attribute to the decussation of fibres in the *medulla oblongata*. For a long time, however, this decussation was supposed to be confined to the anterior columns only; but although in this way the crossed paralysis of motion might be explained, it did not account for paralysis of sensibility following the same law: but Sir C. Bell has lately shown that the middle columns decussate as well as the anterior, which fully accounts for the crossed action of both. (*On the Nervous System*, 3d edit. p. 211, et seq.) It has been moreover objected, 1. that lesions of the cerebellum also produce a crossed effect, although this portion of the nervous system is situated above the point of decussation; and, 2. that paralysis of the face follows the same law, and arises from morbid changes of the opposite side of the brain, although the nerves distributed to it also arise above the decussation. In reply to the first objection it may be remarked, that the dissections of Mr. Solly have demonstrated numerous fibres running between the spinal cord, below the corpus olivare and the cerebellum, which, he has no doubt, actually decussate with their fellows of the opposite side, forming in fact part of the apparatus of decussation, though he has not yet positively ascertained that fact. (*On the Human Brain*, p. 155.) This discovery at least establishes a direct communication between the cerebellum and the spinal cord in the immediate neighbourhood of the decussation, and is an answer to the first objection. With reference to the second, Sir C. Bell has also shown that the fifth pair of nerves arise below the decussation; and Mr. Solly has traced one of the origins of the *portio dura* from the fibres he has described, which run between the spinal cord and cerebellum: thus the sensitive and motor branches of the face ought to follow the same law as the other spinal nerves, which is consonant with what actually takes place. These dissections are in accordance with numerous pathological obser-

vations on record, and appear to us capable of explaining the obscurity with which this subject has been hitherto enveloped.

Cases have been recorded, however, in which paralysis has occurred on the same side as the lesions of the brain. Mr. Hilton, in a paper read before the *Royal Society*, 1837-8, has lately shown a disposition of fibres in the decussation, which he thinks explains this exception to the general law. But there are strong reasons for doubting whether disease in the brain ever causes a direct influence. Of the many thousand cases of cerebral hæmorrhage, softening, tumours, &c., which have occurred, we are only acquainted with twenty-one, in which paralysis is said to have resulted from disease in the same side of the brain; and on analysis, of these more than half are imperfect and doubtful, and should consequently be rejected. As instances, therefore, of this occurrence are so few, may we not consider that the paralysis even in them was produced in the usual manner, and that the morbid lesion had no reference to the complaint? Numerous instances have occurred, of abscesses, softening, and other morbid changes having been found after death, but in which there was no paralysis during life; and a still greater number are on record, in which there was well-marked paralysis during life, but no appreciable change in the structures after death. It is by no means improbable, therefore, as paralysis may be induced without leaving any traces, that in these few cases it was caused by unknown changes in the opposite hemisphere of the brain; and, as is sometimes the case, that the lesion found in the hemisphere of the paralyzed side had produced no effect. Such, we think, is the most probable explanation of these exceptional cases, although the question does not admit of a positive solution.

In the vertebral portion of the spinal cord, lesions produce not a crossed, but a direct, influence, and it may be stated as a general rule, that, whenever structural disorganization, or morbid conditions, interrupt its functions, all the parts furnished by nerves arising beneath the lesion, are affected. Hence the paralysis will be more general, the nearer the lesion of the cord is to the brain. But it sometimes happens, that in the former, as in the latter portion of the nervous system, disease gradually proceeds to a considerable extent, causing more or less disorganization, while such fibres as may remain unaffected, appear sufficient to carry on the necessary functions. Some cases have been recorded, however, in which the individuals have had voluntary movements of the lower extremities up to the moment of their death, and yet, on examination, the spinal cord has been found entirely destroyed. Every one accustomed to pathological examinations, must receive with distrust accounts of such observations, knowing how soon this portion of the nervous system may in certain cases become softened after death, and the injuries it is likely to receive in opening the vertebral canal, particularly in France, where the hammer is used to a most unwarrantable extent. A strict analysis of these cases will show, that there is no absolute proof that the cord was entirely destroyed during life.

In the celebrated case of Desault (*Journ. de Chir. de Desault*, tom. iv. p. 437,) the appearance of the parts is not described: it is merely stated, "the spinal marrow was totally divided;" and the movements which took place are thus narrated:—"He was in a continual agitation, and moved the pelvis and inferior extremities even to the last." In all this there is nothing decided. May not the movements have been excito-motory? Was the altered structure well-observed? The case of M. Rullier (*Journ. de Physiol.*, 1823) has been also frequently alluded to in connexion with this question. It was that of a gentleman who had complete and perfect paralysis of the arms, without loss of sensibility and motion in the inferior extremities; he remained in this state six years, and died of pectoral complaints. Dr. Abercrombie alluding to the case states, that a portion of the cord, six inches in length, occupying two-thirds of the cervical portion and part of the dorsal, was entirely diffuent; so that, before the membranes were opened, it moved upwards and downwards like a fluid. The posterior roots of the nerves of this portion preserved their nervous matter to

their junction to the membranes of the cord; but in the anterior roots it was destroyed, and they were reduced to an empty neurilemma. (*Abercrombie*, p. 350, 3d edit.) This writer mentions that the anterior columns were completely destroyed, and others in alluding to the case have thought a portion of the cord was entirely disorganized. The case itself is headed, *Disappearance (Disparition) of the Nervous Substance of the Spinal Marrow in the Superior Third of the Dorsal Portion* (*Ollivier*, 3d edit. vol. ii. p. 368,) and yet, in the details of the dissection it is stated, "On voyait à peine, vers la partie antérieure de cette portion altérée, les cordons médullaires en rapport avec les racines correspondantes des nerfs spinaux;" and again, "Cette altération était beaucoup moins sensible lorsqu'on regardait la molle par sa face antérieure," &c. From this it would appear that certain continuous fibres still existed in the anterior columns, although they were seen with difficulty, but that there could be no doubt many existed in the posterior. The persistence of voluntary motion and sensibility in the inferior extremities under such circumstances, when the disease too was chronic, is in no way surprising.

Instances have also been recorded, in which balls have traversed the vertebral column; or swords have been thrust into the neck, which are said to have entirely cut across the spinal cord; or, as asserted by Velpeau, that the vertebræ have been found in a state of caries, without being followed by paralysis. We cannot here enter into the analysis of these cases, but those who choose to do so will readily come to the conclusion, that no positive proof exists that the cord was wholly destroyed during life. On the other hand, without throwing any doubts on the accuracy of the observations which have been made, may we not consider that the complete destruction which has been described, is in some degree a post mortem appearance caused by partial softening of the cord, mixing, after death, perhaps, with the serous fluid always present? Is it not probable that the necessary violence in opening the vertebral canal may have broken across the fibres, which during life were entire? Again, may not the movements described in many cases have been excito-motory? At all events we consider that, in the present state of science, such views are much more rational than to suppose that the influence of volition can leap over four or five inches of disorganized spinal cord in order to reach the inferior extremities, or that impressions made on the latter can be communicated to the brain by other channels than the nervous system.

Diagnosis. Paralysis cannot readily be confounded with any other disease. It may, however, be complicated with insanity, or with the febrile, scrofulous, scorbutic, rheumatic and other diseased states of the system.

The diagnosis of the lesion causing the paralysis is often obscure, and in many cases impossible. The most experienced physicians have occasionally committed the greatest errors, in attributing before death the affection to lesion of some particular part of the brain or spinal cord. In the case of an old woman who had hemiplegia of the right side, after momentary loss of consciousness, and who was found in the street unable to rise, we heard one of the most distinguished and experienced physicians for the treatment of cerebral disorders in Paris, publicly diagnose, "softening or extravasation of blood in the neighbourhood of the left ventricle, or hæmorrhage into the arachnoid cavity on the left side." On opening the cranium after death, neither of the three morbid conditions he had predicted was found, but a number of circumscribed, shallow softenings confined to the gray matter, distributed over the whole periphery of the brain, varying in size from a pea to a sixpence. This undoubtedly is a rare case, but illustrates the difficulties which attend the diagnosis, and we are of opinion that there is no physician who has had much experience in paralytic cases, that has not met with similar instances. At the same time, by a careful observation of the symptoms with a knowledge of the history of the case, we are enabled in most instances to indicate with tolerable certainty the morbid lesion that exists.

The symptoms which more particularly indicate the situation of the morbid

lesions are fully detailed in the articles, INFLAMMATION OF THE BRAIN, APOPLEXY, MYELITIS, SPINAL IRRITATION, &c. It must be remembered, however, that the cranial portion of the cord may not only be affected directly by destruction or effusion of blood, but indirectly by congestion, hæmorrhage or other morbid alterations occurring in the substance of the hemispheres. Hence general paralysis may depend upon some cerebral lesion producing pressure upon the cranial portion of the cord, in the same manner as when that or the cervical portion of the spinal marrow is directly affected. The former two may be distinguished by the presence of cerebral symptoms, such as headach and vertigo, derangement of the special senses, &c.; and the latter by the absence of these symptoms, pain in the neck, spinal tenderness, &c.

Hemiplegia almost always depends, as has been already remarked, on some lesion in the opposite hemisphere of the brain to the side affected; sometimes, however, it is produced by alterations of one side of the spinal cord. The former may be diagnosticated by the cerebral symptoms above alluded to, especially those mentioned under the fourth form of apoplexy, and the latter by those characterizing spinal disease.

Paraplegia in general depends upon affections of the spinal cord, but as shown by Dr. Baillie and others, may arise from changes within the cranium. These latter may be known by vertigo, cephalalgia, diminution or loss in the special senses, and such symptoms as we have described under the heads of congestive and organic cephalalgia. Mr. Earle has pointed out the means of distinguishing paraplegia depending on caries of the vertebræ, from that caused by debility in the muscles of the back, inducing slight curvature. In the former the curve is angular; in the latter round, in the shape of a half-hoop. "If a person with such an incurvated state of the spine be placed on a horizontal plane, the back will immediately and spontaneously be restored to its proper form, without causing any pain or distressing symptoms, which would certainly be produced by any attempt at any extension of a diseased spine." (*Med. Chir. Trans.*, vol. xiii. p. 52.) This is important, as curvature with paralysis is not unfrequently seen in weak children, and has often been mistaken for diseased spine.

In local paralysis depending upon lesion of the nerves, those symptoms which characterize cerebral or spinal disease are absent: there will seldom be difficulty in detecting the part injured, if tumours, wounds, fractures, &c. exist. The previous occupation of the patient will indicate the paralysis arising from metallic poisons.

In order to distinguish partial paralysis of the face, arising from affections of the portio dura, or branches of the fifth pair, we refer to what has already been said concerning these forms of local palsy. When the ganglionic portion of the latter nerve is the seat of disease, disorganization of the eye has been observed to take place, as in cases recorded by Alison, Stanley, and Serres. Care also must be taken not to attribute paralysis of the face depending upon disease in the portio dura, to changes occurring within the cranium, although cephalalgia, and a greater or less number of cerebral symptoms, may be complicated with it.

Another important point in the diagnosis is to determine the nature of the morbid lesion. In the present state of pathological knowledge, we have no diagnostic symptoms which indicate an invariable connexion between the paralysis and morbid lesion on which it depends. In many cases, however, extravasation of blood is to be distinguished by the suddenness and intensity of the paralysis. If there be hemiplegia with loss of consciousness, we may predict hæmorrhage within the cranium in the hemisphere opposite to the affected side. Sudden pain in the back, and loss of motion in the parts below it, indicate extravasation of blood into the spinal canal. (See APOPLEXY and SPINAL APOPLEXY.) When paralysis arises from softening, according to Lellemann, there is more or less contraction. This is by no means invariably the case, many instances having been recorded, where no such symptom was manifested; and on the other hand, from the observation of many cases at the Salpêtrière, in

Paris, we are inclined to think it is equally common in cerebral hæmorrhage. The paralysis from softening occurs generally less quickly than that resulting from hæmorrhage; in some cases, however, it is equally sudden, and then it is impossible to draw any distinction between the two lesions. Paralysis from tumours is generally known by its slow progress and circumscribed nature.

The diagnosis of tubercles in the brain and spinal cord has been made in a few cases at the Hôp. des Enfants Malades, in children of a scrofulous diathesis, in whom they are most common between the age of two and eight years (see Dr. Hennis Green, on *Cerebral Tubercle in Children*; *Lancet*, vol. i. 1838-9, p. 755,) and are very rarely met with after the age of twelve.

Cancer in the nervous centres has also been diagnosed, when individuals have suffered under the disease in other parts of the system. Contrary to what has been observed respecting tubercle, cancer is rare before the age of twenty, and most common between that of thirty and sixty.

We have merely alluded to this subject because the nature of the morbid lesion is not made the subject of diagnosis to such an extent as its importance deserves. For the symptoms of paralysis arising from other lesions, we must refer to the articles INFLAMMATION OF THE BRAIN, HYDROCEPHALUS, SPINAL IRRITATION, HYDRORACHIS, &c., &c.

Prognosis. The danger of paralysis is in proportion as it is more or less general and complete. The difficulty of cure increases as the malady becomes more chronic. The prognosis in general must be governed by the diagnosis the practitioner is enabled to make of the seat and nature of the morbid lesion. If this be situated in the brain, or near the origin of the eighth pair of nerves, the prognosis will be very unfavourable. The same may be said if active inflammation exist in the spinal cord, causing paraplegia and involuntary discharges of urine and fæces. On the other hand, local paralysis, independent of disease in the nervous centres, although it may occasion great suffering and inconvenience, is rarely of immediate danger, and in such cases death generally takes place from the secondary effects on the constitution. Very severe cases of paralysis, however, have recovered, and the individuals have lived a long time without illness, and ultimately died of other disorders. Professor Ferguson, of Edinburgh, had hemiplegia at the age of fifty years, and by antiphlogistic treatment got well in a few months. He remained ever after free from the disease, and died at the age of ninety-three. (*Edin. Med. Chir. Trans.*, vol. vii., p. 230.) Such cases, however, are rare. Dr. Cooke says, "I do not recollect more than one or two cases of a complete restoration, both of sensation and motion, in the whole side of a person who had been affected with a perfect hemiplegia;" and this agrees with the general experience of physicians.

The prognosis of paraplegia will entirely depend on the nature and situation of the morbid lesion which causes it, and the extent to which the affected parts have been involved. If it comes on gradually and is chronic, it may exist for years before death, an event which may be ultimately caused by other diseases, or by exhaustion from the sloughs, which are liable to form on the sacrum. Should the neck of the bladder and sphincter ani have lost their functions, the prognosis will be more unfavourable than when the fæces and urine pass voluntarily.

The prognosis in local paralysis varies according to circumstances. If it depend upon division or morbid destruction of the nerves going to the part, the disorder is incurable, but when they are compressed only, the continuance of the paralysis will depend upon the greater or less facility of removing the compressing cause. The paralysis from lead and mercury is, generally speaking, curable, although some cases have resisted every kind of treatment. The longer the individual has been exposed to the poison, and the more complete and extended the disorder, the more unfavourable should be the opinion as to the result.

Treatment. As paralysis is only the effect of some morbid lesion acting directly or indirectly on some part of the nervous system, our treatment must have reference to the pathological conditions on which it depends. The means of combating congestion, inflammation, structural disorganization and other alte-

rations, of which paralysis is occasionally symptomatic, have already been fully treated of in several articles to which we refer. (See APOPLEXY, INFLAMMATION OF THE BRAIN, HYDROCEPHALUS, and SPINAL DISEASES.) In this place, therefore, we shall only describe the treatment of paralysis in its chronic form, or when it is purely local.

When paralysis is chronic, the indications are, 1, to remove the morbid conditions on which it depends, by such means as act on the system generally; and 2, by a stimulating line of treatment directed to the paralyzed part, endeavour to excite the nervous branches to a due performance of their functions. With a view of condensing what we have to state on this subject, we must remark, that the same treatment applies to all forms of paralysis, the various remedies being in general the same, although different parts of the system are affected. Whenever any particular exceptions occur, they will be mentioned.

The general treatment of chronic paralysis must depend upon the age and constitution of the individual. If plethora be present, with the usual signs of increased vascular action, the diet should be low and of a digestible nature. But when there are evidences of debility, light nutritious food should be taken, combined with tonics and moderate stimulants, such as a glass or two of wine at dinner. In all cases the secretions and excretions are to be regularly attended to, and solicited, if necessary, by medicines, the strength of which must have reference to the state of the constitutional powers. Moderate exercise in a carriage, or so managed as to call into action the paralyzed limbs, may be permitted according to circumstances. In local paralysis of the arms and hands, alternately elevating and depressing a weight suspended on a wheel, which weight is gradually increased has been found beneficial. When the legs and feet are affected, walking, short of fatigue, with such support as may be necessary, is the best exercise. Paralytics should never expose themselves to bad weather, or to sudden changes of temperature, and flannel should be worn next the skin. The propriety of change of air and scene, visiting some of the retired watering places, different kinds of amusements, mental or corporeal, and various other remedial means, must depend upon the nature of the case and the discretion of the practitioner.

The second indication is to be fulfilled by the use of such stimulants as act more particularly on the paralyzed parts. These remedies, judiciously employed, have often succeeded in removing the disorder, but for the most part are only applicable when all danger from increased action of the vital powers has ceased. We shall mention such as have obtained reputation in this class of disorders.

With a view of stimulating the nervous extremities, and rousing them to a proper performance of their functions, frictions by the hand or flesh-brush, stimulating liniments of turpentine, tinct. lyttæ, croton oil, and the concentrated acids or alkalies, mixed with oil or lard, strong saline solutions, &c., have been used with occasional benefit. In hemiplegia, when applied to the scalp on the side of the head opposite to the paralysis, they may be useful in facilitating the absorption of the coagulum. Sinapisms, blisters, issues, and setons, have been applied to the neighbourhood of the supposed injury, and are indicated when paralysis follows the drying up of any old sore. In chronic paraplegia this line of treatment over the vertebral column, is the most powerful means we can employ. Pott recommended caustics on each side of the spine, and they have been used since his time with great success. Larrey, Dupuytren, and others, have employed the moxa in the same situation with much benefit, and the actual cautery is perhaps one of the most powerful and useful remedies of this class. Counter-irritation produced by the tartar emetic ointment, or the powder sprinkled on the blistered surface, has been followed by considerable relief. The Acetum Lyttæ, employed in this way, has been found a useful and cleanly application in local paralysis of the face.

Electricity and galvanism have been extensively employed. A paralytic individual is said to have been cured when on board of a vessel which was struck several times by lightning, and another instance of recovery is stated to have

followed a hundred strokes of the *Gymnotus electricus*. A case of hemiplegia cured by a thunderbolt striking a house in which the patient rested, is reported. (*Arch. Gén. de Méd.*, tom. ii. 1836.) No doubt this is an agent which, properly and judiciously employed is of great service in local and partial paralysis, but great caution is necessary in its application. It has been found beneficial in numerous cases, since it was first introduced for the treatment of this disorder by M. Jalabert in 1747, but, in a host of others, has produced no amendment, and has latterly fallen into undeserved neglect. The reason of this may, in a great measure, be attributed to the insufficiency and improper state of the apparatus often employed. From many trials we have seen made of this remedy, it appears that the method of passing shocks through the part is not so beneficial as insulating the patient, and drawing sparks from the affected surface. In this manner, many cases which have come under our notice have been perfectly cured by an electrizing quack, and a great number of others much relieved; but the apparatus was very large, of great power, and kept in the most perfect order. The stimulating effects of this remedy, however, may be injurious in plethoric states of the system, attended with vertigo. In such cases antiphlogistic medicines should be given, with a view of diminishing the vascular excitement, before having recourse to it, and care should be taken not to continue its application when symptoms of cerebral or spinal irritation appears. It is also dangerous after recent apoplectic attacks from hæmorrhage, and should not be used until sufficient time has elapsed for the coagulum to be absorbed.

Galvanism also has been used in several cases with great success, and by some is preferred to electricity. Dr. J. L. Bardsley, in particular, has highly recommended its use, and has given cases in which its beneficial operations was very manifest. The same precautions must be attended to in the use of this remedy, as in that of electricity. Dr. Castana has cured a great number of patients labouring under facial hemiplegia by galvanism, and applies it by placing the positive wire inside the lips and cheeks, and the negative wire externally on the face in the course of the nerves. (*Journ. des Connais. Méd. Chir.*, Dec. 1835.) It results from the researches of Pichonnière, confirmed by the observations of Bottu-Desmortiens, that galvanism excited by certain acids, as the nitric, produces more pain than when others are employed, as the sulphuric. (Bottu-Desmortiens, *Thèse*, 1834, No. cccxv.)

Both electricity and galvanism have been found most useful in the various forms of paralysis, arising from exposure to cold, metallic poisons, and in cases unconnected with structural disorganization. They have been found beneficial, also, in certain cases of amaurosis, cophosis, and aphonia, and may be conjoined with the administration of other remedies.

In partial paralysis of the face, electro-puncturation has been found beneficial by Pichonnière, Bally, and Montault. The latter cured a severe case of this description, with neuralgia of the portio dura of the same side, by inserting a needle through the nerve at its exit from the stylo-mastoid foramen, and four others in the course of its principal branches, and transmitting from the former to the latter a number of shocks once a-day, from a pile of thirty couples.

Strychnia and brucia. Various remedies, which owe their activity to the presence of these alkaloids, have been given with success in several cases. Dr. Alderson of Hull recommended the *rhus toxicodendron*, M. Fouquier the *nux vomica*. The *arnica montana*, or leopard's bane, *rhus vernix*, or varnish-sumach, and *Ignatia amara*, or St. Ignatius's bean, &c., have also been given. The alkaloids themselves are now generally used, as the doses may be better regulated. Andral, from comparative trials has established that six grains of *brucia* are equal to a quarter of one grain of pure *strychnia*. This drug acts as a powerful stimulus to the muscular system, and especially on paralyzed parts, a circumstance Dr. M. Hall attributes to the augmented irritability in such parts. It produces involuntary contractions in the muscles affected, and in large doses general spasms of a tetanic nature, delirium, and death. It is seldom met with pure, and its

strength consequently varies. The twelfth to an eighth of a grain should be taken for a dose in the form of pills, which is to be cautiously increased. Dr. A. T. Thomson recommends the acetate as a preferable preparation, which is readily procured by dissolving one grain of the alkaloid in a fluid drachm of distilled vinegar. Six minims should be given at first; this dose to be gradually increased until the tetanic twitchings appear. If there be irritability of the stomach, preventing the internal administration of the preparation, strychnia in powder may be sprinkled on a denuded surface in double the dose given by the mouth. It is always necessary to produce twitchings and slight spasms of the paralyzed parts, before any benefit can be excepted, and in several cases the restoration has been found proportionate to the severity of these. Numerous instances have been recorded in the British and Foreign Journals, in which strychnia given in this way has been beneficial. Dr. J. L. Bardsley mentions twenty-three cases of paralysis, in the majority of which this remedy was undoubtedly beneficial. (*Hosp. Facts and Observ.*) Brucia acts in the same manner, but is not so powerful. Half a grain may be used at first, which may be increased to two grains twice a-day. It should always be remembered that these medicines are uncertain in their action, and should not be given indiscriminately. They are contra-indicated if there be cerebral or spinal irritation, and have been found most useful in paralysis which is purely local, and independent of irritation, as in palsy connected with metallic poisoning and rheumatism, although they have been occasionally beneficial in hemiplegia and paraplegia. They should, however, be employed with the utmost caution, and not resorted to till other means have failed.

The warm bath is beneficial in many cases of partial paralysis, especially hemiplegia. The Bath waters have been much extolled; and their moderate use, conjoined with other remedies, may be serviceable. Care must be taken, however, that they are not used too long, or too frequently, as under such circumstances they are apt to prove relaxing. The cold bath has been employed, and is spoken favourably of, by Cullen. The same cautions are necessary in its use, as we have just mentioned with respect to the warm bath, as when long continued, or too cold, it is a powerful sedative. It is consequently inadmissible in persons of a debilitated constitution. Such individuals derive more benefit from the tepid bath, the temperature of which should be gradually lowered as the general strength of the patient improves. The vapour bath has been found very useful in the paralysis from lead complicated with colic.

Opium and hyoscyamus may be given in some forms of paralysis attended with much pain, when there are no severe cerebral symptoms. In partial paralysis of the face, attended with distressing pricking or lancinating pains, we have seen opium plasters applied over the parts, where the affected nerves come out on the face, often useful. These remedies may also be given internally in such cases, to relieve the watchfulness which is often harassing.

B A R B I E R S.

Symptoms.—Causes.—Morbid Anatomy.—Diagnosis.—Treatment.

THIS disease was first described by Bontius (*De Medicina Indorum*), but is better known to the Profession from the observations of Dr. Clark (*On the Diseases which prevail in long voyages in Hot Countries, &c.*, vol. i.) and Mr. Marshall (*Notes on the Medical Typography of Ceylon, &c.*) These writers have separated the affection from Beriberi, with which it has been confounded even by Good, and shown that while the latter is a disorder allied to the dropsies, that of which we now treat is purely nervous.

Symptoms. The disease usually commences with more or less lassitude and pricking pain, or sensation of formication in the muscles of both lower extremities, accompanied with numbness, tremors, and irregular spasmodic movements during locomotion. Occasionally the fore-arms and hands are similarly affected, and in some cases the spasmodic action extends to the muscles of the larynx and chest, so that speaking and respiration are performed with great difficulty. As the disease advances, the inferior extremities become more and more rigid, the knees are spasmodically bent, so that the legs are straightened with much difficulty, and instantly relapsed into the flexed position when the effort ceases. These symptoms are increased on standing or walking, these efforts rendering the performance of both unsteady, and at length the patient is incapable of performing either without support. After a time the upper extremities become similarly affected, and inactivity, great torpor, and loss of sound sleep are complained of: the numbness in the affected limbs now increases, till at length they become completely paralytic, much emaciated and contracted, and lose their natural temperature. The general health also suffers; there is loss of appetite, indigestion, wasting, and general sinking of the vital powers; the pulse latterly becomes weak, thready or fluttering, and death takes place, apparently from a gradual decay of the contractility of the muscular fibre.

The above description refers to the severest form of the disease, but more frequently the symptoms are much milder: the affection is essentially chronic, and generally continues several months, and sometimes years.

Causes. This disease is common in several parts of India, but chiefly in Ceylon, and on the Malabar coast. It occurs most frequently in Europeans, and those generally are attacked who are exposed to the land winds, and are intemperate in their habits. (*Lind.*) Wright describes it as most prevalent towards the end of the rainy season, when the night temperature is many degrees lower than that of the day. (*Edin. Med. and Surg. Journ.*, vol. xli. p. 235.) Mr. Marshall states that late comers are more liable than long residents, and that he never noticed it among the inhabitants of the island. Much contradiction, however, prevails regarding the various circumstances which may induce the disease, and a complete memoir on this subject, derived from actual observation, is still a desideratum. As far as our present knowledge, however, extends, the causes appear to be, "cold and moisture applied to the body; intoxication, irregularities and excesses consequent upon inebriety; violent exercise in the sun; lying down

in the open air during the heat of the day; exposure to the cold chilling dews of the night, or sleeping when thus exposed; suddenly obstructed perspiration by currents of air; long fasting, and whatever exhausts the energies of life." (*Copland.*)

The morbid anatomy of this disease, and consequently its pathology, is very imperfect. It appears, however, to be a species of palsy, affecting more especially the contractility of the muscles, and the functions of the nerves distributed to them. Whether this is to be attributed to morbid changes occurring in the spinal cord, or in the extremities of the nerves themselves, we know not: at the commencement, the disease often resembles chronic rheumatism, and at a later period paralysis from the poison of lead.

Diagnosis. Barbiers may be distinguished from all other diseases by the slow and continual progress of the tremors, spasms, rigidity and contraction of both inferior extremities, with more or less paralysis. Such, however, is the endless variety of nervous affections, and the almost imperceptible differences which sometimes exist between the exceptional cases of one disorder and those of another, that it is occasionally difficult to say, what (nosologically speaking) is the disease under which certain patients labour. Thus Dr. Bostock has recorded a case occurring in England, in which the symptoms very much resemble those now described; and Dr. Copland says, that for several years he has been occasionally consulted by a patient, whose complaints are very nearly the same as those which constitute barbiers. In the countries, however, where the disease is common, the only malady with which it is likely to be confounded is beriberi; barbiers may be distinguished by its being essentially chronic, presenting phenomena of a nervous nature, and terminating in death slowly from inanition, whilst beriberi is an acute affection: and although there may be nervous symptoms, it is principally characterized by general œdema, dyspnœa, and the suddenness of its fatal termination, often with symptoms of asphyxia.

The *treatment* of this disease is in every respect similar to that recommended for lead palsy, and creeping paralysis with debility, and we have nothing farther to add to what has been recommended in the article PARALYSIS.

INFLAMMATION OF THE EYE.

General remarks on ophthalmic inflammations and their classification.—I. Inflammation of the conjunctiva.—(a) Catarrhal ophthalmia—symptoms—causes—diagnosis—treatment.—(b) Purulent ophthalmia of infants—symptoms—causes—treatment. Of adults—symptoms—causes—treatment.—(c) Gonorrhœal ophthalmia—symptoms—causes—treatment.—(d) Strumous ophthalmia—characteristic symptoms—causes—treatment.—(e) Variolous ophthalmia—symptoms and treatment.—(f) Morbillous and scarlatinous ophthalmia—symptoms and treatment.—(g) Erysipelatous ophthalmia.—II. Inflammation of the sclerotica—symptoms and treatment.—(a) Catarrho-rheumatic ophthalmia—symptoms, causes, and treatment.—III. Inflammation of the cornea—symptoms, causes, and treatment.—IV. Inflammation of the iris.—(a) Acute idiopathic iritis—symptoms—causes—diagnosis—treatment—varieties.—(b) Syphilitic iritis—symptoms, diagnosis, and treatment.—(c) Rheumatic iritis—diagnostic symptoms and treatment.—(d) Arthritic iritis—symptoms, causes, and treatment.—(e) Strumous iritis—characters and treatment.—V. Inflammation of the retina—symptoms of the acute—of the chronic—causes—diagnosis—treatment.—VI. Inflammation of the choroid—characteristic symptoms, causes, and treatment.—VII. Inflammation of the lining membrane of the aqueous chamber, and of the lens and its capsule.

THE eye is a very complex organ, exhibiting in its structure almost every tissue of which the body is composed, besides several peculiar to itself, as the cornea, the iris, the choroid, and the retina. From the varied character of its component parts two inferences may be drawn, viz. its liability to many different diseases, and its possession of a wide range of sympathies, through which its vital phenomena may be variously influenced.

Its diseases therefore are more or less identical with those of the other organized tissues, and the same principles of treatment are applicable to both. Dr. Mackenzie has very justly remarked, that the knowledge of the inflammatory diseases of the eye has been greatly retarded by the practice of confounding them all under the name of ophthalmia, and thus overlooking both the seat of the disease and the peculiar nature of the inflammation. The consequence of thus viewing all those diseases without discrimination, has been a method of treating them equally preposterous. We find, for example, that the remedies which in the course of a few days are sufficient completely to remove inflammation of the conjunctiva, only aggravate inflammation of the sclerotica or iris, while the plan of treatment which speedily cures scleritis or iritis, if trusted to in conjunctivitis, would expose the eye to almost certain destruction. (*Pract. Treat. on Dis. of the Eye.*)

The symptoms of the ophthalmia generally may be considered under two heads—the *objective*, or those which we ascertain by the direct exercise of our senses, and the *subjective*, or those which we gather from the testimony of the patient. Among the former, the increased vascularity of the part is a condition generally well marked; and as the arrangement of the blood-vessels is peculiar, and generally constant in different species of ophthalmia, it forms an indication of much value in their diagnosis. A simple inspection of their appearance is frequently

sufficient to denote the nature and seat of the malady, without the necessity of a single interrogation. Four different arrangements of the blood-vessels have been enumerated—the *reticular*, the *zonular*, the *fascicular*, and the *varicous*. The first and third are chiefly seated in the conjunctiva, and are characteristic of diseases of that membrane: the second and fourth belong to the fibrous textures, and are most strongly marked in inflammation of the sclerotica and the deeper tissues of the eyeball. Although perfectly distinct from each other, two or more may be combined, as in the compound ophthalmiæ. The appearance of the secretion from the eyes should also be attended to, as it differs widely in inflammation of the mucous and fibrous tissues.

Under the second head of symptoms, or the subjective, the nature of the pain is a distinctive mark of some moment in some forms of ophthalmiæ. Thus in inflammation of the conjunctiva it is of a sandy character, superficial, and felt most during the day; while in inflammation of the sclerotica, iris, and fibrous textures generally, it is deep-seated, pulsative, and strikingly nocturnal, affecting the circumorbital region as much as the eye itself; commencing soon after sun-set, it increases in violence till after midnight, and abates towards morning. Ophthalmiæ, attended by the conjunctival or sandy pain, are generally curable by external applications: those accompanied by the pulsatory circumorbital pain always require depletion.

With regard to the classification of ophthalmic inflammations, the most simple and practical appears to be according to the structure in which they are seated. This we propose to adopt, following very nearly that given by Dr. Mackenzie in his *Treatise on Diseases of the Eye*.

I. INFLAMMATION OF THE CONJUNCTIVA.

(a) *Catarrhal Ophthalmiæ*.

There are three ophthalmiæ, Dr. Mackenzie observes, which are frequently excited, especially in adults, by atmospheric influences, viz. the *catarrhal*, the *rheumatic*, and the *catarrho-rheumatic*. The first of these is puro-mucous or blennorrhœal inflammation of the conjunctiva; the second an affection of the fibrous sclerotica; while in the third, both the conjunctiva and sclerotica are attacked, the symptoms of catarrhal being united to those of rheumatic ophthalmia. (*Op. cit.*, p. 399.)

Symptoms. Catarrhal ophthalmia generally commences with redness and itching of the palpebral conjunctiva, a feeling of stiffness in the eyes, and some degree of lachrymation and intolerance of light, which is succeeded by pricking pain, accompanied with a sensation as of sand or some other foreign body beneath the upper eyelids. The intolerance of light (*photophobia*) subsides as the disease advances; but the overflow of tears often continues, probably from the swelling of the lachrymal passages presenting a mechanical obstacle to their transmission.* The vascularity† which first appears on the conjunctiva of the lids, and in slight cases does not extend beyond it, presents itself in the form of irregular clusters of tortuous vessels of a bright scarlet colour, which may be

* There exists no photophobia so long as the ophthalmia is simply catarrhal and uncombined with scleritis, and the tears, the passage of which through their natural channel is only mechanically obstructed, are not increased in quantity or acrimony. Photophobia and lachrymation are almost pathognomonic of rheumatismal ophthalmia.

† The vascularity of the lids is marked rather by a uniform velvety redness, intermixed frequently with granulations, while that of the ocular conjunctiva is regular in its arrangement, composed of trunks emanating from the angle of reflexion of the mucous membrane, running tortuously in radii towards the cornea and bifurcating before reaching this membrane so as to leave a space of a line around it free from injection.

traced advancing from the palpebræ and posterior surface of the globe towards the cornea. As the disease is developed, they gradually assume the reticular arrangement, forming a general network over the whole globe. These vessels are quite superficial, and can easily be moved upon the subjacent textures by pressure with the finger, or motion of the lids. Patches of extravasated blood are sometimes observed beneath the conjunctiva, or even a pretty general but slight ecchymosis: slight œdematous swelling of the conjunctiva is occasionally observed, but never any thing like true chemosis. The conjunctival secretion is increased in quantity, and becomes opaque and puriform;* sometimes, however, it retains its natural transparency, imparting an appearance of unusual moistness to the eyes, and to the patient a sensation of glueyness. The eyelids are united in the morning by the formation of crusts upon the cilia, of a yellow colour.

Vision is somewhat disturbed by the mucosities which descend upon, and sometimes obstinately adhere to, the cornea. Besides the local symptoms just enumerated, Jüngken, of Berlin, and Mr. Lawrence mention the occasional appearance at the edge of the cornea of small vesicles or pustules filled with yellow lymph, which burst, leaving round aphthous ulcers of a harmless character. By Dr. Mackenzie this symptom is considered as distinctive of a variety of strumous ophthalmia. When the local symptoms are mild, there is no constitutional disturbance: but in severe cases, and especially when accompanied with the consentaneous affection of other portions of the mucous surfaces, the usual symptoms of pyrexia are developed: when headach is present, it is generally felt across the forehead; sometimes it does not amount to more than a sensation of weight in the situation of the frontal sinuses. The symptoms are generally of a remittent character, becoming milder during the day, and returning with increased severity towards evening.

Causes. Exposure to the vicissitudes of the atmosphere; the irritation caused by a glare of reflected light, or by the presence of foreign matters, as dust, &c., in the eye; over-exertion of the organ by reading or writing to a late hour of the night; and, generally speaking, all those influences, whether atmospherical or otherwise, by which inflammation of mucous surfaces is usually excited, may be enumerated as the occasional causes of catarrhal ophthalmia. Instances are not wanting, both in this country and on the Continent, in which this disease appears to have prevailed *epidemically* over considerable districts. Its *endemic* existence is of still more frequent occurrence.

Besides its origin from atmospherical influences, some authors are of opinion that it is decidedly contagious, especially in those cases in which the discharge is distinctly puriform; and that the conveyance of the matter by the fingers, nails, &c. to a sound eye, "will excite a conjunctivitis still more severe, more distinctly puriform, and more dangerous in its effects upon the cornea, than was the original ophthalmia." (Mackenzie, *Pract. Treat.*, p. 403.) We have certainly observed some facts which tend to confirm the opinion of its being propagable by contact.

Diagnosis. From rheumatic ophthalmia, or inflammation of the fibrous membrane of the sclerotica, the catarrhal is distinguished by the absence of circum-orbital pain and intolerance of light, by the predominance of the mucopurulent over the lachrymal secretion, and by the position, colour, and arrangement of the blood-vessels, which form a striking contrast in these respects to the pinky hue and deep-seated, parallel, radiated course of those observed in sclerotitis. We frequently find these diseases combined, when the symptoms present a mingled assemblage of those peculiar to each, although one or other generally predominates. (See *Catarrho-rheumatic Ophthalmia*.) Occurring in indivi-

* When the secretion is puriform, the cornea may become affected by the conversion of its external laminæ into a pulpy matter. When granulations crowd upon the cornea it is frequently the seat of an interlaminar deposit of pus; and finally when the granulations persist for a long time, the friction to which the cornea is subjected in the movements of the eyelids may produce a vascular keratitis (pannus.) J.

duals of a strumous habit, catarrhal ophthalmia presents various modifications, for an account of which we must refer to the description of strumous inflammation of the eyes.

"From *purulent ophthalmia* it is distinguished by its much milder character; yet the two affections approximate, especially when we compare the severest catarrhal with the mildest purulent inflammation; the difference is rather in degree than kind, unless it be established, which it is not at present, that the latter always is, and the former always is not, contagious." (Lawrence, *Treat. on the Dis. of the Eye*, p. 155.)

Treatment. If the patient is young and plethoric, the local symptoms severe, and the general febrile disturbance considerable, venesection may be necessary, followed by cupping or the application of leeches, and perhaps scarification of the conjunctiva. The leeches should be placed in the hollow of the temple, over the cheek bone, or upon the side of the nose over the angular vein, and not upon the lids. Scarification of the conjunctiva ought to be performed by making one or two deep incisions with a lancet, the point of which is rounded off, the whole length of the inner surface of either eye-lid; a considerable discharge of blood will take place, and by proper management of the lids it will continue to flow for some time. The bowels should be well cleared by one or two doses of a brisk purgative, and the action of the skin promoted by the use of warm pediluvia and diaphoretic medicines, as Dover's powder, the Liq. Ammon. Acetat. or tartar-emetic in small doses. Abstinence from animal food and fermented liquors should be enjoined, and the action of the bowels should be maintained by occasional doses of the neutral salts. If the weather be fine the patient may be permitted to go out, and if the light be found to irritate the eyes, a broad pasteboard shade, covered with green silk or calico, should be worn.

With regard to local applications, a variety have been proposed, both astringent and soothing, and either cold or tepid. During the acute stage, a mild tepid application is generally the most agreeable to the feelings of the patient, and most in accordance with what common sense would dictate. We may use for this purpose, either warm water or decoction of poppy-heads, which should be applied by means of a piece of flannel or soft sponge wrung out of the liquid and held beneath the eye, in order that it may be enveloped in the steam. Any mild unctuous substance, as the Ung. Cetac. or cold cream, should be introduced between the lids at night, to prevent their adherence during sleep. Some practitioners make use of highly stimulating applications from the very commencement of the disease, the propriety of which is very questionable, when the inflammatory symptoms are at all severe. Others, among whom is Dr. Mackenzie, rely upon a local treatment of a moderately stimulating character, combined with measures of general and local depletion. As a collyrium he employs a solution of gr. j of the bichloride of mercury with gr. vj of the hydrochlorate of ammonia in 3viiij of water, to be used tepid several times daily. The sandy pain is relieved and the inflammation abated, by dropping into the eye, once or oftener daily as circumstances may require, a solution of gr. iv of nitrate of silver in 3j of distilled water; and the bulk of a grain of hempseed of an ointment containing gr. iss of red precipitate to 3j should be smeared along the edges of the palpebræ at bed-time.*

If the disease manifests a tendency to become chronic, a blister applied to the nape or behind the ears, and kept open, will prove serviceable. The condition of the internal surface of the lids should be frequently examined; if rough and sarcomatous, it will be necessary to scarify the lining membrane and touch it lightly with the solid sulphate of copper or nitrate of silver.

While we are of opinion, that general remedies in this disease are by no means to be relied upon, and that great evil frequently results from their exclusive em-

* We learn that compression, so valuable an antiphlogistic in acute inflammation of other organs, has lately been employed by Velpeau in the treatment of ophthalmia, with very favorable results.

ployment, we believe that there are many local applications which may be used with nearly equal advantage. The solution of alum and of the various metallic salts have each their advocates, and in the hands of judicious practitioners have each succeeded in effecting a cure. With regard to the treatment recommended by Dr. Mackenzie, we can confidently testify to the success which attends it both in his practice and our own.

(b) *Purulent Ophthalmia.*

Purulent ophthalmia occurs under three different forms, which are yet essentially the same disease; the first two distinguished only by circumstances arising out of the age of the patient, the last (*gonorrhæal ophthalmia*) presenting some peculiarities which are perhaps referrible to the specific nature of the cause. (See Lawrence's *Treatise*, p. 163.)

Purulent Ophthalmia of Infants. This form generally commences on the third day after birth, although it may occur a few days later, and during the first stage is confined to the mucous lining of the palpebræ. The edges of the lids are observed to adhere firmly by a hardened secretion, and presents a redder appearance than natural, especially towards the angles. If the lids are separated, a drop of thick white fluid escapes from between them, and on everting them we find the conjunctival lining red and villous, while that investing the globe is natural. During the second stage there is progress in all the symptoms; the swelling and vascularity of the conjunctiva increases; the purulent secretion becomes copious, firmly uniting the edges of the lids, collecting beneath them, or oozing out in considerable quantity when they are separated, and the palpebral integuments assume a dark red hue. The child keeps its head constantly averted from the light and its eyes shut, if they are not already closed by the tumefaction of the lids. The chemotic swelling of the conjunctiva, pressed upon by the orbicularis muscle, causes eversion of either or both lids, which may be permanent, or only occasional during a fit of crying, or on attempting an examination of the affected organ. The discharge from the eyes, though generally of a yellow colour, may present a greenish hue in unhealthy children; sometimes it is ichorous or mixed with blood, or whitish in appearance. The disease may continue in this state for eight days or even longer, without any injury to the transparent parts, farther than a slight haze of the cornea. About the twelfth day purulent infiltration of the cornea is liable to occur, and that membrane gives way by ulceration, either in a spot of circumscribed dimensions, or throughout its whole extent, so that on examining the eye after the occurrence of this untoward accident, we may find merely a small penetrating ulcer with a hernia of the iris, or the whole cornea destroyed and the humours prolapsed through the pupil. The other injuries to vision consequent upon this ophthalmia are, opacity of the cornea from interstitial deposit either into the conjunctival layer or into its substance, producing a loss of transparency varying in degree from a thin bluish gray film to complete opacity, and limited to a circumscribed portion, or including the whole extent of the cornea. Adhesion of the iris to the cornea, constituting what is termed "synechia anterior," may also occur; and finally a central opacity seated in the anterior hemisphere of the capsule of the lens, generally about the size of a small pin's head, is a not unfrequent result of this ophthalmia. Both eyes are usually attacked, either simultaneously or with an interval of several days. The constitutional symptoms accompanying the complaint are, restlessness, loss of sleep, a loaded tongue, and disordered bowels; if it is neglected, feebleness and emaciation frequently result from the prolonged irritation.

Prognosis. Though purulent ophthalmia be very manageable in its early stages, in the advanced it assumes a serious character, especially if neglected or mismanaged. The issue, therefore, depends on many circumstances. If the cornea still retain its transparency, however violent the inflammation and profuse the

discharge, the sight will be preserved, although the cure may be tedious if the disease has been allowed to establish itself. Opacity from thickening of the corneal conjunctiva will disappear completely, but superficial ulceration of the cornea, or morbid deposition in its substance, will lead to the production of opacities more or less injurious to vision; and if purulent infiltration has taken place, the organ may be destroyed and vision permanently lost. Protrusion of the iris through a penetrating ulcer of the cornea will occasion a permanent alteration in the form of the pupil; and should this occur in the axis of vision, total loss of sight may result from the pupillary margin of the iris becoming engaged in the aperture: in such cases vision may perhaps be restored in after life by an operation for artificial pupil. If there is central capsular opacity, the probability is that it will remain unaltered, and though vision may improve by the expansion of the pupil as the child advances to maturity, permanent short-sightedness may be occasioned.

Causes. Authors agree in referring this complaint, in the majority of instances, to the inoculation of the conjunctiva during parturition with leucorrhœal, gonorrhœal, or some other morbid discharges:* its occurrence, however, in the offspring of apparently healthy mothers who deny the existence of vaginal discharge in any form, must leave the source of the disease, in such cases at least, doubtful, and hence its contagious origin still remains open to dispute. Simple catarrhal ophthalmia may, however, possibly degenerate into this form of disease under the influence of various causes which tend to impart to it a degree of malignancy.

Treatment. Before proceeding to the employment of curative means, it is of great importance that we should ascertain distinctly the actual condition of the affected organ, and especially the progress which the inflammation has made with reference to the transparent parts. This of course can only be satisfactorily accomplished by separating the lids and exposing the cornea, an operation which is frequently rendered very difficult by the state of the parts and the restlessness of the little patient. Nevertheless, when it can be accomplished without the exercise of undue violence, it ought to be attempted, and by adopting the following suggestions of Dr. Mackenzie we shall generally succeed:—Let the surgeon, after spreading a towel upon his knees, receive between them the head of the infant, which the nurse, sitting opposite and a little to one side of him, supports across her lap. On attempting to separate the lids by drawing at the skin, eversion almost invariably takes place from the contraction of the orbicularis muscle upon the swollen conjunctiva; we must, therefore, place the points of the fingers against the anterior edges of the tarsi, and press them firmly but gently backwards over the globe. If we fail in obtaining a view of the cornea, we must rest satisfied with what information can be obtained from the external condition of the lids and the nature of the discharge which issues from beneath them.

In the acute stage of the disease if there is bright redness and swelling of the ocular conjunctiva, and especially if the cornea is hazy or in a doubtful condition, it will be necessary to abstract blood from the part; and even when we cannot see the eye itself, if the palpebræ are much swollen and of a bright red externally, local depletion is not less advisable. It may be effected by scarification of the inflamed membrane, or, what is better, the application of a single leech to the upper eyelid: from the vascularity of the skin it will bleed freely, and this is generally followed by marked diminution of the inflammatory symptoms. One leech is generally sufficient, or at most two, even in robust children. The bowels should be opened with castor oil or magnesia, which may be repeated occasionally. When the tongue is white and the inflammation active, a grain or two of calomel may be given once or oftener as required; small doses repeated daily are often very beneficial. Counter-irritation by blistering has been recommended, but unless absolutely

* Sichel considers the cases arising from inoculation as exceptional. The real causes are difficult to trace; it frequently exists endemically in hospitals where children are crowded together—but it also as frequently occurs sporadically, generally at periods when catarrhal affections are prevalent, probably from the same causes, as it commences with all the anatomical symptoms of catarrhal ophthalmia.

necessary, it is better to avoid it in infants. The eyes should be frequently bathed with tepid water, gently separating the lids and removing the purulent matter with a bit of soft sponge; the upper and lower lids are alternately to be everted and wiped clean; if the former remains everted, it may be easily replaced by compressing the swollen conjunctiva and bringing down the edge of the lid. A little cold cream or fresh butter should be smeared along the edges of the tarsi to prevent their adhesion, and consequent dilatation of the palpebræ by the accumulated discharge. Having subdued the violence of the inflammatory symptoms by the use of antiphlogistic means, we must have recourse to astringents, which may be used with more safety and advantage in this ophthalmia than in any other. For this purpose we may employ the bichloride of mercury collyrium already mentioned, or a solution of gr. iv of alum, which may be gradually increased to gr. x, in 3j of water. With either of these washes the eyes ought to be bathed three or four times in the twenty-four hours, and the fluid injected with a syringe between the palpebræ. As it is advisable to vary the stimulant occasionally, the solution of the nitrate of silver (gr. iv to 3j of water) should be applied daily with a large camel's hair pencil to the whole surface of the inflamed conjunctiva, after cleaning it as already directed.

When disorganization of the cornea is threatened, and the constitutional symptoms indicate debility, the system must be supported by tonics, as quinine, in doses of gr. ss twice or thrice daily. If the conjunctiva continues in a relaxed condition during the decline of the disease, we may touch it daily with the Vin. Opii; or if it presents a sarcomatous or granular appearance, strong nitrate of silver ointment or the solid caustic may be applied. Mr. Guthrie employs an ointment consisting of ten grains of nitrate of silver in an ounce of axunge from the very first. Its application in the acute stage of this or any other ophthalmic inflammation must be attended with great pain, and we are not aware of any particular advantage which it possesses over the treatment just recommended. With the exception of Mr. Guthrie himself, we do not find any author of experience who seems to favour its application, unless in the chronic stage, when a powerful stimulant is universally allowed to be beneficial. As the purulent discharge in this disease is highly contagious, those in attendance on the child should be made aware of the fact, and cautioned against whatever might favour its communication to themselves or others.

Purulent Ophthalmia of Adults. This form, known also by the name of Egyptian Ophthalmia, when severe, is a most formidable disease, sudden in its attack, rapid and often uncontrollable in its progress, and destructive in its effects, varying in degree from a slight affection of the conjunctiva of the lids to an intense inflammation of all the structures of the eyeball, and frequently terminating in ulceration and rupture of the cornea, with destruction of vision. It generally affects both eyes, though not simultaneously, and commences with an itching uneasiness in the conjunctiva of the lids, or a sudden sensation, as of a particle of sand lodged between the eyelids and globe: next morning the palpebræ are found to be adhering, and the lining membrane is highly vascular and greatly swollen. The discharge is profuse; at first mucous it speedily becomes purulent, collecting in considerable quantity in the interstices of the tumefied membrane, and escaping abundantly from between the eyelids, irritating and excoriating the skin of the cheeks over which it flows. The swelling of the conjunctiva continues to increase, and in severe cases is raised by the inflammatory œdema in the form of pale red, soft elevations, or chemosis, round the cornea, so as at times completely to overlap and conceal it, producing excessive distention of the palpebræ or protruding from between them and causing eversion. The pain varies in degree, according to the textures which are involved; if the conjunctiva alone suffers, it is inconsiderable, but when the deeper and firmer tissues are attacked, it becomes almost insupportable. It is felt chiefly in the neighbourhood of the orbit, and is of an aching, pulsative character, subject to remissions and exacerbations of variable duration. There is sometimes hemicrania, accompanied with an agonizing sense of tension in the eye; in other instances the whole head is affected. The pre-

sence of light during the paroxysm does not appear to aggravate the pain. With local suffering of such severity, we find some degree of constitutional sympathy in the form of fever, and the general health is at times much impaired by the prolonged irritation.

A characteristic of the disease is its tendency to relapse. When the inflammation has apparently expended its strength, it may be again rekindled and rage with increased violence. Rupture of the cornea, which sometimes occurs during a paroxysm of pain at variable periods from the commencement of the disease, may afford a temporary relief to suffering; but this is not always the case, as sometimes it does not put a termination to the disease, and scarcely even checks its progress. If resolution takes place, the inflammation may issue in the production of various morbid conditions of the eye and its appendages, as vascular thickening of the palpebral conjunctiva with enlargement of its mucous papillæ, commonly called "granular conjunctiva," opacity, ulceration, sloughing, or staphyloma of the cornea, or prolapse of the iris.*

The inflammation may subside into a *chronic* form, characterized by a thin gleet discharge, a moderate degree of pain, and a vascular condition of the corneal conjunctiva, dependent upon the rough and thickened state of the lining membrane of the upper lid, by which vision is materially abridged, or even totally destroyed. From this chronic form the disease readily passes again into an active state, under the influence of various exciting causes.

Causes. The opinion of authors is divided as to whether this disease is merely an aggravated form of common catarrhal ophthalmia, or whether it arises from a specific contagion, produced in warmer climates and imported into this country: the weight of evidence is certainly in favour of the former opinion. However originating, there can be little doubt that when it occurs in circumstances favourable for the development of contagious disease, it presents that character, and is capable of being propagated by contact from one individual to another, acquiring additional virulence from the circumstances which at first favoured its origin. That it may also be communicated by miasmata conveyed through the air from the eyes of those affected with the disease, is asserted by Müller, denied by Dr. Vetch (*Pract. Treat.*, p. 179,) and considered doubtful by Dr. Mackenzie (*Pract. Treat.*, p. 419,) who remarks that "in every instance in which this ophthalmia has spread through a regiment, school, or family, there has been a suspicion of actual contact by means of the fingers of the patients, or of the towels or other utensils which they used in common." "In practice," says Mr. Lawrence, "it is the safest course to proceed upon the notion of the complaint being contagious; and, acting upon that notion, to prohibit the use of the same sponges, utensils, or linen, or any other thing capable of communicating the disease from one to the other, just as if the contagious nature were decidedly proved."

Treatment. On this subject Mr. Lawrence remarks (*Treatise*, p. 211,) "there are in short, two points to be kept in mind in treating acute purulent ophthalmia—first, to check inflammation by antiphlogistic means, and then to employ astringents: if we proceed on this plan, we shall prevent that chronic thickening and granulation, which are so obstinate and troublesome."

To proceed on these principles, if the patient is robust and plethoric, and there is much deep-seated and circumorbital pain with chemosis of the conjunctiva, general bleeding should be practised. Venesection is preferable to arteriotomy, and equally effectual. The quantity abstracted ought in all cases to be such as will produce a decided effect upon the disease. Dr. Vetch strongly recommends that the blood be allowed to flow till *deliquium animi* is produced. (p. 206.) We must be cautious, however, not to carry this practice too far, as the disease cannot be cured by it alone: the patient's strength may be so reduced, as materially to favour disorganization in the textures of the eye. After venesection,

* The granulations generally occur at a very early period of the disease, increase in number and size, and collect in groups in different portions of the conjunctiva, and remain even after the subsidence of the inflammation.

blood may be abstracted locally by cupping or leeches. In severe cases from twenty to thirty of the latter may be applied round the eye, avoiding to place them upon the lids: this additional depletion should follow the general blood-letting by about two hours. If the symptoms continue unabated, or have increased in severity, the venesection may be repeated in twenty-four or thirty-six hours.

Scarification of the swollen conjunctiva of the globe and eyelids with deep incisions is strongly recommended by Dr. Mackenzie, who regards it as one of the most effectual methods of combating this disease, the copious bleeding which ensues tending greatly to allay the symptoms. Mr. Lawrence disapproves of scarifications in cases of acute ophthalmia, as tending to augment the local irritation. Walther advises the excision of large portions of the chemosed membrane after general bleeding has been premised, while Sanson recommends its entire removal, and the cauterization of the bleeding surface with lunar caustic in substance.

The bowels should be freely moved by mercurial purgatives, which may afterwards be exchanged for milder aperients. Rest, and a strict antiphlogistic regimen should be enjoined. In mild cases leeching and cupping will probably suffice, with the exhibition of purgatives, which ought not in any case to be neglected, from the powerful sympathetic influence which they exert upon the conjunctiva. As soon as the active inflammation has been subdued, diaphoretics may be prescribed, as a full dose of Dover's powder at bed-time, accompanied with warm pediluvia and diluents. There is a difference of opinion as to the free employment of mercury in this disease. Rust recommends its exhibition when the inflammation is advancing unchecked despite of antiphlogistic measures. Mr. Lawrence states, that his experience corresponds with that of Vetch and Walther, who have seen salivation produced in many instances without the smallest advantage. Dr. Mackenzie considers the exhibition of calomel and opium, preceded by general bleeding, as very useful in severe cases attended with nocturnal circumorbital pain, and advises it to be given in the proportion of gr. ij of the former and gr. $\frac{1}{4}$ to gr. j of the latter every two hours, thrice a-day, or only at bed-time, as the case may require, till the mouth is affected. Counter-irritation is of the greatest service; after depletion a suppurating surface should be opened by blistering upon the nape or behind the ears.

The local treatment ought to partake both of a soothing and stimulant character, but the protracted use of the one, or the premature employment of the other, is equally injurious. Cold applications to the inflamed organ have been recommended by high authorities, as of great utility in reducing the vascular action. If perseveringly employed, on the first appearance of the disease, no doubt this may be the case; but when the inflammation is fully developed, the feelings of the patient must be generally against them. Mr. Travers decidedly prefers a tepid application in the painfully acute stage of inflammation, an opinion in which we concur. Considerable benefit is sometimes derived from exposing the eye to the vapour of hot water and laudanum, and the temples may be rubbed with warm laudanum before the nocturnal attack of circumorbital pain sets in. The purulent discharge should be frequently and carefully removed from the eyes with the bichloride of mercury collyrium used tepid, and injected over the whole conjunctival surface by means of a syringe. Dr. Vetch recommends very strongly an infusion of tobacco, in the proportion of 3ij of the leaves to 3viiij of water, and the undiluted Liquor Plumbi Diacetatis, as collyria in this stage of the disease. (*Op. cit.*, p. 211.) Some mild application should be applied to the edges of the eyelids at bed-time. When the acute inflammatory symptoms have been subdued, the treatment must be changed, and astringents of greater activity employed: the gr. iv solution of the nitrate of silver is one of the best, and ought to be dropped into the eye every five or six hours, or whenever the raw painful feeling is renewed: in the intervals the bichloride of mercury collyrium may be continued, or a solution of alun (gr. ix to gr. x in 3j of water.) The red precipitate, or the citrine ointment, which is highly recommended by Sir P. Macgregor, may now be substituted for the milder applications previously used. Mr. Briggs employs the Ol.

Terebinth. introduced between the lids, as an effectual means of checking the profuse discharge: he applies it in minute quantities with a camel's hair pencil, afterwards bathing the eye with cold water till the heat and uneasiness produced are allayed. In employing astringents it is necessary closely to watch their effects, discontinuing their use, and having recourse again to antiphlogistic measures upon any renewal of the inflammation and pain. With change of local treatment may be conjoined better diet, exposure of the eye to light, and exercise in the open air. Dr. Vetch and Mr. Murray speak highly of the good effects of exercise in the open air upon the soldiers affected with this disease, even during the existence of chemosis and purulent discharge.

As the state of the pupil frequently cannot be ascertained during the progress of this disease, the extract of belladonna ought to be rubbed into the forehead or temples to dilate it, and prevent those abnormal adhesions of the iris which, though comparatively rare in any of the puro-mucous ophthalmiæ, occasionally take place to the cornea from a penetrating ulcer.

Evacuation of the aqueous humour by puncturing the cornea has been suggested as a means of relieving the intense pain of the eye and head, and preventing the rupture of that membrane. Sir P. Macgregor, who performed it in twenty-three cases, speaks very favourably of its good effects. If ulcers form upon the cornea, they must be touched with the lunar caustic pencil sharpened to a point. This practice is especially useful when a portion of iris protrudes through the ulcer. Spreading ulceration of the cornea attended with debility will require a decided tonic and stimulating treatment, viz: good diet with porter or wine, quinine, and local astringents. (*Lawrence*, p. 211.) The *Vin. Opii* is an excellent application in the relaxed condition of the conjunctiva, which frequently remains after the acute inflammatory symptoms have disappeared, and the puriform discharge has ceased. Besides the plan of treatment above recommended, and which in general we should consider the safest and the best, it has been proposed by some authors of experience and merit, to cut short the disease at the commencement by the free use of powerful astringents; and certainly their testimony goes far to establish the utility of this practice while the disease is confined to the mucous lining of the palpebræ, or is just beginning to spread to the conjunctiva of the globe. Dr. Ridgway employed the gr. x solution of the nitrate of silver, to which Dr. O'Halloran added the use of the sulphate of copper in substance, which he freely applied to the inner surface of the eyelids, not only in the early stage of the disease, but also when the purulent discharge and chemosis were fully established. Mr. Guthrie's nitrate of silver ointment may be employed for the same purpose; but if we deemed it advisable in any case to adopt this mode of treatment, we should certainly prefer the lunar caustic pencil rapidly passed over the diseased membrane to any other form of stimulant.

(c) *Gonorrhæal Ophthalmia.*

Having already given a detailed account of purulent ophthalmia in the adult, we shall now describe at length the symptoms or consequences of this disease, which differs from that referred to rather in origin and degree than in kind. The vehemence of its attack, and the rapidity with which it runs its brief but destructive course, render gonorrhæal ophthalmia decidedly the most dangerous inflammation to which the eye is subject, and fortunately it is one of the most rare.

The *symptoms* are those of ordinary purulent ophthalmia in the highest degree of development, intense general external redness, great vascular congestion, chemosis and swelling of the lids, and profuse yellow discharge. The palpebral and ocular conjunctiva are generally attacked simultaneously, and to this membrane the inflammation is at first confined, but speedily extends to the cornea and fibrous tissues of the eyeball, this being marked by severe and agonizing pain of the globe, orbit, and head, accompanied with general febrile disturbance. Such a combination of symptoms indicates the most imminent danger to the organ; and, indeed, if

the inflammation has spread beyond the mucous membrane, we can scarcely expect by any treatment to arrest completely its destructive course. From the excessive swelling and eversion of the lids and the great chemosis, it is frequently impossible to ascertain the precise condition of the cornea. When the pain is intense, we may suspect its implication in the disease; but sometimes that symptom is very slight in degree, or even entirely absent. The symptoms are by no means of equal severity throughout the progress of the disease, being generally aggravated as the inflammation advances from the yielding membrane of the palpebræ to the denser textures of the globe. The principal disorganizing changes to be apprehended are thus concisely stated by Mr. Lawrence: "The immediate effects of this inflammation upon the cornea are sloughing, suppuration, ulceration, and interstitial deposition, while the consequences to which these changes lead more remotely are, escape of the humours and collapse of the globe, obliteration of the anterior chamber and flattening of the eye, staphyloma, prolapsus iridis, obliteration of the pupil, corneal opacity, and anterior adhesion of the iris." (p. 220.)

Causes. Gonorrhœal ophthalmia has been referred, 1. to the inoculation of the conjunctiva with the matter of gonorrhœa; 2. to metastasis of the inflammation from the mucous lining of the urethra to the analogous tissue of the eye. With reference to the first, the cases related or referred to by Messrs. Allan (*Syst. of Path. and Oper. Surg.*, vol. i., p. 153,) Mackenzie (*op. cit.*, p. 438,) and Lawrence (*op. cit.*, p. 227,) sufficiently establish in our opinion the possibility of its being thus communicated. With regard to the opinion of its metastatic origin, it is probably erroneous: the testimony of observation is certainly against its occurrence. In none of the cases observed by Mr. Lawrence, in which this ophthalmia coexisted with or supervened upon gonorrhœa, was the urethral discharge stopped; and although generally lessened in quantity, it continued in some instances with little diminution; while, on the other hand, the sudden suppression of gonorrhœal discharge, when effected by surgical means, is not succeeded by inflammation of the eyes.

Treatment. The antiphlogistic plan in all its details has been carried to its utmost extent in this disease, and with very variable success, in some instances proving effectual for the preservation of sight, while in others it has as signally failed, and indeed, "in many cases the result must be unfavourable whatever plan is adopted; because, from the rapidity and violence of the disorder, irreparable mischief has been done before assistance is demanded."

It has been proposed to cut short the disease in its early stage by the application of strong astringents and escharotics, as the gr. x solution, or the ointment of the nitrate of silver. From the frequent failure of the antiphlogistic mode of treatment this method is worthy of a trial in favourable cases, as when the inflammation has not yet extended beyond the conjunctiva; and even when the cornea is affected, from the generally unfavourable termination of such cases under any plan of treatment, Mr. Lawrence thinks that these local measures might still be tried, blood-letting being premised or accompanying their application. (p. 230.)

If antiphlogistic measures are determined upon, they must be vigorously pursued to be of any service. Provided the cornea is still uninjured, in a doubtful condition, or only partially sloughed, we may hope by copious and repeated venesection to preserve its integrity in the former case, or some degree of vision at least in the latter. If suppuration and sloughing to any extent has taken place, such activity of treatment is unnecessary, though moderate depletion may still be requisite. In some cases general bleeding is demanded for the mere relief of the intense suffering attendant upon the disorganization of the denser tissues of the eyeball without any reference to the preservation of sight.

Having thus checked the extreme violence of the inflammatory action, the local abstraction of blood by leeches, scarification, or excision of a portion of the chemosed membrane, will probably suffice for the removal of the slight remaining symptoms. The bowels must be freely moved by active purgatives, and their due

action, as well as that of the skin, maintained by appropriate means: a low diet and rest will complete all that is necessary in the treatment of the acute stage of this disease. Dr. Mackenzie recommends the employment of calomel and opium, as in contagious ophthalmia: counter-irritation may be resorted to as an auxiliary means, antiphlogistic measures having been premised. The eyes should be frequently bathed with the bichloride of mercury collyrium to remove the discharge, and the edge of the lid smeared with some mild unctuous substance. When the inflammation has been completely checked, leaving the patient pale and weak from the effects of the previous treatment, it may be sometimes necessary to give general tonics, as quinine, and employ astringents locally, though Mr. Lawrence thinks such measures are rarely required. Mr. Travers, on the other hand, recommends a careful but prompt exhibition of tonics, with the use of astringent lotions, in this stage of the disease. The best astringent applications are, the alum or nitrate of silver solutions formerly mentioned, with which may be combined the use of the red precipitate ointment. Ulcers of the cornea may be touched with the lunar caustic pencil.

Besides the severe form of disease above sketched, Mr. Lawrence describes (p. 232) a gonorrhœal inflammation of the conjunctiva, comparatively mild in its symptoms, and much less dangerous in its results; it readily yields to the astringent plan of treatment, rarely requiring antiphlogistic measures, unless in patients of a full habit.*

(d) *Strumous Ophthalmia.*

Strumous ophthalmia is peculiarly a disease of childhood, nine-tenths of the cases of inflammatory affections of the eyes in young subjects being of this nature. It seldom attacks infants previous to weaning; from that period to puberty is the season of life when it most frequently appears. It rarely occurs, however, in adults, unless they have previously suffered from the disease.†

Strumous ophthalmia has its primary and essential seat in the conjunctiva and Meibomian glands, although it may secondarily extend to the tissue of the sclerótica and iris. It is characterized by moderate vascularity of the conjunctiva, a copious lachrymal secretion, and a degree of intolerance of light which is quite disproportioned to the urgency of the concomitant symptoms.

The palpebræ are firmly closed by the spasmodic action of the orbicularis, and the child seems to be unable to open its eyes by the light of day, even when willing; or if it does succeed by a convulsive effort, the cornea is immediately rolled upwards beneath the margin of the tarsus, so as to be completely hid from view; an effect which equally follows the forcible separation of the lids, and renders an examination of the cornea a matter of no small difficulty. Were we to estimate the severity of the other symptoms by the degree of intolerance of light,‡

* All these various forms of ophthalmia are regarded by Siehel as of the catarrhal type, and are collected together under the general term "Blenorrhœic Ophthalmia." Purulent ophthalmia, both in adults and children, and Egyptian ophthalmia, he considers as identical in their nature, only more or less modified by the circumstances which preside over their formation and march, and by the age of the individuals attacked. Even gonorrhœal ophthalmia, much as it differs by the nature of its cause from the others, differs very little in its symptoms, march, and duration. He proposes to distinguish by the word blenorrhœic the milder forms of these ophthalmiæ. While the term blenorrhagic will indicate those in which the symptoms are not acute.

† Siehel admits another primary seat for strumous ophthalmia—the cornea, producing a serofulous keratitis, not vascular. Our author treats also of this, p. 316.

‡ This is a mistake made by almost all authors who do not distinguish between simple strumous ophthalmia and serofulo-rheumatismal ophthalmia, in which the sclerótica is in-

we should frequently be surprised, on quickly separating the lids, to find the eye nearly natural in appearance. We mention the *quick* separation of the lids, because an exposure of a few seconds to the light is sufficient to cause copious injection of the conjunctiva, and an appearance of vascularity which it would not otherwise present; a source of fallacy in estimating the amount of inflammatory action present, which it is well to be aware of.

The vessels observed upon the conjunctiva, and sometimes confined to the inner surface of the palpebræ, generally of a somewhat dusky hue, are either single, or arranged in fasciculi, and direct their course to the margin of the cornea, over which they pass, terminating towards its centre. At the extremities of these vessels, small phlyctenulæ or pimples, containing a clear or yellowish fluid, are formed, which speedily burst, and give place to a small round funnel-shaped ulcer. These phlyctenulæ are also observed upon the sclerotica, and very frequently at the line of its junction with the cornea; they vary both as to number and size, being generally smallest upon the cornea.

The degree of pain is generally moderate while the eyes are shaded from the light. When the inflammatory symptoms are active it is considerable, especially during the night. The secretion from the eyes is evidently of an acrid nature, from the irritation it occasions in the nostrils and upon the integuments of the face, which become red and inflamed, and are sometimes affected with a pustular eruption. The foregoing local symptoms are attended with a disordered condition of the stomach and bowels; the tongue is foul; the breath often fetid, and the evacuations of an unhealthy character. The temper becomes irritable and fretful, and this tends to prolong the disease.

Towards evening, especially after sunset, there is a considerable remission in the symptoms, which have been aggravated during the day; a phenomenon which is not observed in any of the other forms of ophthalmia.

Both eyes are usually affected, though not in an equal degree; or the disease may commence in one and pass to the other, or attack them alternately.

The strumous diathesis is farther indicated by various morbid appearances in other parts of the body, some of them evidently produced by the acrid secretion from the eyes, others apparently originating in the general unhealthy condition of the system.

From the insidious nature of this form of inflammation, and the frequent absence of any prominent symptom, the most serious organic changes may have taken place in the transparent textures of the eye, tending materially to abridge, or even totally destroy vision, before we are aware of the danger with which they are threatened.

The organic changes most to be apprehended are, ulceration of the cornea, and the deposition of opaque matter in its substance.

The phlyctenulæ which we have already described as forming upon this mem-

involved, as long as the affection is simple, it is confined to the conjunctiva, and the injection is peculiar, composed of vessels of tolerable size, slightly tortuous, united in groups, generally at the inner or outer margin of the eye, ordinarily constituting a triangle, the base of which almost touches the circumference of the cornea, without, however, passing beyond it. Beneath this injection the sclerotica is seen of its natural whiteness. As the affection advances these groups of vessels spread out so as to cover a greater surface, appear dilated, of a deep red, and intermixed with veins; but still so long as the disease is confined to the conjunctiva, no matter what may be its degree, there is not the slightest epiphora or photophobia; nor unless there is complication, is there increased mucous secretion—in a word, the epiphora and photophobia depend upon a rheumatic complication, while the increased mucous discharge depends upon a catarrhal complication. There is, however, in the most simple form of strumous ophthalmia, a spasmodic contraction of the eye-lids. It must be recollected, then, that the description here given combines the symptoms of scrofulous ophthalmia, serofulo-catarrhal ophthalmia, and serofulo-rheumatical ophthalmia.

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brane may be absorbed, and the remaining opacity be entirely removed, or a transparent dimple of the cornea may be left, which is long in filling up. In other cases the opacity is observed to extend itself, and red vessels run into it, forming what is named "vascular speck," which is a very troublesome symptom. More frequently the phlyctenulæ burst, and form ulcers which may be superficial and considerable in extent, but are generally deep and infundibuli-form. This change is usually preceded by the appearance of red vessels running to the phlyctenulæ, a symptom indicative of much danger to the eye, from the frequency with which the ulcer penetrates to the anterior chamber, causing protrusion of the iris, and subsequent adhesion of that membrane to the cornea. The ulcer, when healed, leaves an opaque permanent cicatrix, which, however, may be in some degree lessened by contraction upon itself, or by the growth of the patient. If several phlyctenulæ co-exist upon the cornea, they may unite previous to bursting, infiltrating their contents into the substance of the cornea, and forming a species of *onyx*, which is sometimes observed at the edge of the cornea, independently of this cause.

It frequently happens, that while the entire thickness of the corneal substance has been penetrated by an ulcer, the lining membrane of the aqueous chamber still remains entire, and by the pressure of the contained humours is protruded through the opening in the form of a small vesicle, forming what is termed "hernia corneæ." Should this give way, as generally happens, the aqueous humour escapes, the iris is prolapsed, and a dense opaque cicatrix is the result.

If the corneal ulcer has been of considerable size, and the iris extensively prolapsed, the pseudo-cornea which has been formed over the protruded portion of iris, sometimes gives way before the pressure of the humours, forming a partial staphyloma. A general protrusion of the whole cornea may take place from the same cause, when its texture has become weakened by inflammatory action, and the iris is adherent to its posterior surface. The transparency of the cornea may be farther impaired by interstitial deposit, or the ramification of red vessels in its conjunctival layer forming a vascular net-work, which has been named "pannus." The inflammation may be propagated from the cornea to the sclerotic and iris, and may even extend to the deeper-seated structures, producing serious organic changes of the internal parts, especially when the disease is of long standing, and has frequently renewed its attacks. The globe may be enlarged by an increased secretion of the humours, a degree of hydrophthalmia being thus produced; while in other cases it is observed to be dwarfish and atrophic, and apparently the result of interrupted nutrition.

Frequent and long-continued attacks of strumous ophthalmia generally leave the eyes in an imperfect condition, and predisposed to become amaurotic, under the influence of causes which would not have similarly affected them in other circumstances.

Dr. Mackenzie (p. 469) describes, under the name of *Pustular Ophthalmia*, another form of strumous inflammation of the eye, which differs in several respects from that which we have just described. The subjects of it are generally children of somewhat advanced age, or young adults. It is not attended with danger to the transparent textures of the eye, and readily yields to a very simple mode of treatment. As its name indicates, it is characterized by the formation of pustules, generally of considerable size, filled with an opaque yellow matter, and usually seated a line or two distant from the margin of the cornea: they burst and are converted into broad elevated ulcers. The vascularity of the conjunctiva is fascicular and confined to the vicinity of the pustules. Sometimes it is pretty general over the surface, and accompanied with conjunctival ecchymosis. This ophthalmia is often combined with catarrhal conjunctivitis. The intolerance of light is generally moderate in degree, sometimes wholly absent; and we never observe the spasmodic contraction of the lids so frequently attendant upon the ordinary form of strumous inflammation of the eyes.

Causes. This form of ophthalmia, as its name implies, occurs in individuals

of scrofulous diathesis, in whom the morbid predisposition may be called into action by various causes, as the use of unwholesome food, excess or irregularity of diet, residence in bad air, and neglect of exercise; to which may be added exposure to cold and wet, teething, over-exertion of the eyes, the presence of irritating bodies in the folds of the conjunctiva, slight blows, &c.; and it is a not unfrequent sequela of exanthematous fevers and whooping-cough.

Treatment. Originating as this disease unquestionably does in an unhealthy condition of the system, we cannot expect that any mode of treatment will prove effectual for its cure, which is not in a great measure directed to the improving and confirming of the general health. Unless this ultimate object is kept constantly in view, and perseveringly aimed at, the most appropriate local treatment will prove altogether unavailing.

As strumous ophthalmia is almost invariably attended with an unhealthy condition of the digestive organs, our first care must be to restore and ensure the due performance of their functions. It will be necessary to administer purgatives, and those too of an active nature even in young children: large quantities of morbid feculent matter are thus frequently removed; and a brisk purge, several times repeated, will in some instances suffice to effect a cure. The purgative plan of treatment has been recommended as especially useful when the ophthalmia is accompanied with an impetiginous eruption over the body; but we must be cautious not to carry it too far, from the debility which may ensue. After thoroughly clearing the bowels of their unhealthy secretions, we may exhibit mild alteratives. In some cases attended with heat of skin, a quick pulse, and a foul tongue, we may commence the treatment more advantageously with an emetic, and afterwards small doses of tartar-emetic (to children $\frac{1}{12}$ to $\frac{1}{16}$ of a grain) thrice a-day. Antimony combined with the sulphate of magnesia, and administered so as to keep up a state of nausea and catharsis, is a mode of treatment well adapted to acute cases in adults.

Blood-letting, either general or local, is seldom requisite, and intolerance of light alone is not to be recorded as an indication either for its employment or repetition. If there be considerable redness and pain of the eye with general fever, leeches must be applied. It may be necessary to repeat them frequently, if the local symptoms continue urgent, and the constitution will bear the depletion; though it must be borne in mind that depletion alone will not effect a cure, and we may often as effectually subdue the disease, while we save our patient's strength, by the exhibition of tartar-emetic. Repeated bleedings, to the neglect of other means, are highly pernicious; tending to increase the irritability of the affected organ, and by reducing the patient's strength, to render the transparent textures of the eye more susceptible of destructive changes.

Tonics are peculiarly useful in this disease, from their effects in removing the constitutional debility upon which it in a great measure depends. After the alimentary canal has been sufficiently cleared by the exhibition of purgatives, we may commence their use; and the di-sulphate of quinine seems to be the most eligible form. Dr. Mackenzie, who has used it extensively, says, "In most of the little patients to whom I have administered sulphate of quinine, it has acted like a charm, abating commonly in a few days the excessive intolerance of light and profuse epiphora, promoting the absorption of ptyectenulæ, and hastening the cicatrization of ulcers of the cornea." (P. 460.) A healthful condition of the skin should be promoted by the use of the tepid bath, or daily ablution of the body with tepid salt water, followed by gentle friction. The temperature of the water may be gradually reduced, till the cold plunge, or shower-bath, can be borne with advantage.

Among constitutional remedies we ought not to omit to mention the marked benefit which is frequently derived from change of air, especially by the removal from the impure atmosphere of a large town to the more salubrious air of the country.

Mercury or its preparations, though usually administered in this disease for

their purgative effects are sometimes employed with other intentions. Their deleterious influence however upon strumous habits, should deter us from their exhibition, except as purgatives or alteratives, unless imperatively demanded, as to arrest disorganization of the transparent textures of the eye. In these circumstances, calomel and opium may be given till the gums are affected, or the Hydrarg. e. Cretâ, either singly or combined with James's powder, or the Pulv. Ipecac. Comp.

Counter-irritation is highly beneficial, and is often effectual in speedily removing the intolerance of light. Its mode of application is a matter of some difficulty in very young subjects, and requires to be conducted with caution. If we prefer a blister, it ought to be applied between the shoulders or behind the ears, and should be removed in six or eight hours at farthest: it is safer to repeat the application after a short interval, than to keep up a discharge by the use of irritating ointments. The position of the child during sleep is a matter of some moment: it ought on no account to be permitted to lie burying its face in the pillows; nor, unless absolutely necessary, should it be allowed to remain in bed during the day.

Local remedies. Scarification of the conjunctiva of the lids has been recommended, especially in chronic cases, and may sometimes be employed with advantage. Warm fomentations are employed with much advantage when the symptoms are at all severe, affording much relief to the photophobia and spasm of the lids. A bit of flannel, or soft sponge, wrung out of a decoction of poppyheads, or chamomile flowers, or an infusion of opium, may be applied to the eyes as hot as it can be borne; or they may be exposed to the vapour of laudanum, or of a vinous solution of belladonna, raised by mingling it in a cupful of hot water; warm bread and water poultices during the night are sometimes beneficial.

When the symptoms are moderate and the attack recent, evaporating or slightly stimulating lotions are frequently effectual in removing the complaint. The solution of a grain of the bichloride of mercury in 3viij of simple or rose water, is as useful a form as any: it should be employed tepid to bathe the eyes several times daily.

In severe attacks, when the acute inflammatory symptoms have been subdued by the treatment already pointed out, stimuli of considerable strength may be applied to the surface of the eye with decided benefit. The most useful are the gr. iv solution of the nitrate of silver, the red precipitate ointment, and the Vinum Opii. They have a marked effect in diminishing the irritability of the organ, in promoting the healing of ulcers of the cornea, and in dispersing the opacities which these may have occasioned. The red precipitate ointment should be introduced between the lids at bed-time every night, or every second night; and any other stimulant which is selected ought to be regularly applied once a-day, or every two days.

When large ulcers exist upon the cornea, a stronger solution of nitrate of silver than that mentioned above may be applied directly to their surface with a camel's hair brush, or the lunar caustic pencil filed to a sharp point may be employed. The latter is especially useful in deeply penetrating corneal ulcers, or when there is protrusion of the iris from the anterior chamber having been opened. The prolapsed portion may be touched with it every second or third day.

In deep central ulceration of the cornea, the extract of belladonna should be smeared over the eyebrow, or an ointment containing this substance rubbed into the temple and forehead: its effect in dilating the pupil is sometimes sufficient to free the iris, even when involved in an ulcer of the cornea. The eyes should be protected from the light by the use of a broad green shade, and guardians of children ought to be cautioned against binding up their eyes with handkerchiefs, a common and most pernicious practice. It is not necessary to confine the patient to a dark room, exposure to the air when the weather is fine being decidedly beneficial.

In cases of "vascular speck," the removal of a portion of the enlarged vessels which supply it, is one of the most effectual means of arresting its progress.

With regard to the treatment of the *pustular* form of strumous ophthalmia, a few words will suffice. The pustules or ulcers should be touched daily with solid caustic, or a strong solution of nitrate of silver, and the eyes bathed with the bichloride of mercury collyrium. After the exhibition of a few smart purges, it has been recommended to give chalybeates, as the sesquioxide of iron, in the dose of from gr. x to xx thrice daily: we have seldom found this necessary, the disease yielding readily to stimulating local applications.

(e) *Variolous Ophthalmia.*

The sympathy which is observed to exist between the skin and the mucous membranes in a state of health, is equally exhibited in their morbid conditions; and in no instance is it more strongly marked than in the exanthemata, in all of which the eye is apt to suffer, sometimes very severely. Previous to the introduction of vaccination, variolous inflammation of the conjunctiva was a frequent cause of serious injury to vision, or even of its complete destruction. The variolous pustules may be confined to the integuments of the palpebræ, or they may be developed on any part of the conjunctiva of the eye; constituting *true* variolous ophthalmia. When they occupy the former situation, and are numerous as in the confluent form of the disease, they are attended with great swelling of the lids, by which the eyes are completely closed; while the augmented conjunctival and Meibomian secretions being confined by the incrustations which bind together the cilia, tend to increase the irritation of the organ and the patient's suffering. As the disease subsides these more immediate effects of the inflammation may pass away and the eye escape uninjured, though we more frequently find that both the eye and the lachrymal apparatus have materially suffered.

Among the changes of structure usually resulting from the formation of pustules upon the palpebræ, may be enumerated complete destruction or an abnormal position of the cilia, unsightly marks upon the tarsi, irregularity of their edges, or superficial ulcerations and excoriations with an irritable condition, which from slight causes is apt to pass into chronic ophthalmia of a very obstinate character. Chronic inflammation of the lachrymal sac and strumous inflammation of the conjunctiva are also frequent consequences of small-pox.

True variolous ophthalmia is characterized by the formation upon the conjunctiva of the pustules peculiar to this disease: they may be seated in any part of the membrane, though the greatest danger is to be apprehended from their development upon the corneal layer. The disease is essentially the same on the cornea as on the skin, though in the former case its effects are serious and destructive, while in the latter they are comparatively insignificant. From the great tumefaction of the lids, it is frequently impossible to ascertain by inspection the actual condition of the eye; but if there is pain of the globe aggravated by motion or exposure to light, a feeling of dryness and stiffness of the eye with a sensation as of sand in it, and increased lachrymation and discharge, we may infer the existence of acute variolous inflammation, and consequently imminent danger to vision. If the above symptoms are absent, the disease is probably confined to the palpebræ. The pustules of the palpebral conjunctiva are small and of a yellowish colour. Upon the cornea they commence by small whitish points, which gradually become elevated and yellow. The suppuration extends to the substance of the cornea, and a pointed elevated pustule is formed, which is sometimes succeeded by onyx. The inflammation may extend to the deeper tissues of the eye.

Total or partial loss of sight will result from these disorganizing processes. Suppuration or sloughing of the cornea is followed by a greater or less degree of opacity, which may or may not be attended with synechia anterior. Prolapse of

the iris, or staphyloma, will follow penetrating ulcers, and in severe cases almost the whole of the cornea may be destroyed by purulent infiltration and ulceration.

Should the eyes escape during the early stages of variola, they are still liable to become the seat of a pustular eruption during the decline of the disease in other parts of the body: from this circumstance it has been named, "secondary variolous ophthalmia." The period of its attack varies from two to six weeks after the apparent termination of the primary complaint, with which it is identical in character; and though milder in degree, it is still not unattended with danger to vision. One or more pustules may form on the cornea, their development being accomplished in the manner already described, and accompanied with redness of the sclerotic coat, lachrymation, pain, and increased sensibility to light. This form of the disease seldom terminates in destruction of the cornea. The matter of the pustules is either entirely absorbed, leaving no trace of the disease; or ulceration takes place, and opacities varying in degree are the result. The injury to vision is often less serious than the aspect of the disease in its early stages would lead us to anticipate.

Treatment. When the eruption is limited to the integument of the eyelids, besides placing the patient in a moderate temperature and upon a cooling regimen, with the use of tepid ablutions, we may adopt some *local* measures to moderate the irritation occasioned by the pustules. The face should be covered with a soft cloth spread with some mild cerate, or fomented frequently with chamomile decoction, or tepid milk and water. When the pustules are matured their contents may be evacuated by pricking them, and the succeeding incrustation removed, after being well softened with some unctuous application, or tepid wash. M. Serres recommends the pustules to be opened and thoroughly cauterized with the solid nitrate of silver. (*Traité de l' Ophthalmie, &c.* par J. Sichel, p. 460.)

In true variolous ophthalmia, when the pustules have extended to the conjunctiva of the lids and globe, and to the cornea, active antiphlogistic measures seem alone to afford any chance of saving the organ, but unfortunately these are not always admissible. If the propriety of general bleeding is questionable, local depletion by leeches to the temples or behind the ears may be resorted to with advantage, and followed by a blister if necessary. Mercurial purgatives should also be freely administered. From the swollen condition of the palpebræ it is frequently impracticable to make any application to the inflamed conjunctiva; but the external surface may be bathed frequently with poppy decoction or tepid water, and the edges of the lids may be smeared with cold cream after removing the incrustations. As soon as the state of the parts will admit of it, a weak solution of nitrate of silver or diluted Vin. Opii should be injected between the lids.

In the treatment of the secondary form of the disease, the exhibition of tartar emetic has been recommended as tending to abate the inflammation, and promote the absorption of the pustules and onyx. Leeches and blisters may also be required. When the acute inflammatory symptoms have been subdued, quinine may be given with advantage. Undiluted Vin. Opii should be applied once daily to the conjunctiva, and belladonna smeared over the eyebrow as a precautionary measure to keep the pupil dilated. M. Serres recommends the adoption of his mode of treatment for pustules seated upon the cornea, as well as for those upon the integuments of the lids.

(f) *Morbillous and Scarlatinous Ophthalmia.*

The ophthalmia which usually accompanies measles and scarlatina is neither so severe in its nature, nor so injurious in its consequences, as that attendant upon variola; bearing the same relation to the latter in degree which is observed to exist between the cutaneous inflammations in these several exanthemata.

The conjunctiva, participating in the morbid condition of the cutaneous circulation, exhibits some degree of redness accompanied with intolerance of light, slight pain, and increased lachrymal discharge. The cornea sometimes becomes the seat of phlyctenulæ, ulcers, or onyx, especially in scrofulous subjects, and indeed it is difficult to distinguish this form of inflammation from ordinary strumous ophthalmia till the eruption appears. In weakly children, or from the neglect of proper treatment, ulceration of the cornea and staphyloma have sometimes resulted from the ophthalmia attendant upon measles, and Mr. Lawrence has observed the same occurrence in that accompanying scarlatina. Opacities of the capsule of the lens, and affections of the iris, have been observed in some rare cases to ensue from scarlatinous ophthalmia.

Treatment. Active treatment is not required in these ophthalmiæ. The eyes should be frequently bathed with some cooling wash and protected from the light. The patient ought to be freely purged, and if the symptoms are unusually severe, a few leeches may be applied to the temples, followed by a blister behind the ear or to the neck. The nitrate of silver solution and the di-sulphate of quinia will be found highly useful when the acute symptoms have yielded.

(g) *Erysipelatous Ophthalmia.*

Inflammation of the eyes from the extension of erysipelas of the face to the conjunctiva is frequently observed, but idiopathic erisipelatous inflammation of the conjunctiva, a form of ophthalmia described by some authors, is of rare occurrence. It is chiefly characterized by the elevation of the ocular conjunctiva in the form of vesicles round the cornea, which are of a soft consistence and yellowish red colour; the natural secretions of the part are augmented, and there is some degree of pain; the disease seems disposed to subside of itself, and does not demand any treatment beyond the puncture of the vesicles, and the exhibition of an aperient and diaphoretic. It is chiefly observed in individuals of cachectic habit, and may be caused by atmospherical changes, slight blows, and the stings of insects.*

II. INFLAMMATION OF THE SCLEROTICA.

Rheumatic Ophthalmia, or, as it has been termed, *Sclerotitis atmospherica*, may be defined to be an inflammation of the sclerotica and surrounding fibrous tissues of the orbit: it rarely exists alone, being either accompanied from the first, or speedily followed, by a degree of inflammation of the conjunctiva. The iris and cornea suffer to a certain extent, though, unless from neglect or mistreatment, serious change of structure in either is not usually observed.

Symptoms. There is general bright redness of the globe of the eye, specially developed round the cornea, towards the margin of which the radiated sclerotic vessels may be observed advancing, and along with those derived from the conjunctiva, passing over it to the extent of about half a line, forming a fine vascular wreath, encircling the cornea either wholly or in part, and in which all the vessels are observed to terminate with sharp points, and at an equal height; none pass beyond it, the rest of the cornea remaining free. This arrangement and mode of termination of the vessels is considered by Jüngken to be characteristic of *Rheumatic Sclerotitis*. (*Lehre von den Augen Krankheiten*, p. 231.)

As the inflammation extends to the lining membrane of the aqueous chamber,

* The conjunctiva rather offers a general appearance of infiltration, with a confluent pale yellowish or reddish injection; the secretions are scarcely augmented; there is no intolerance of light or injury to vision, and the pain seems to be confined to a disagreeable sensation of prickling or tension, owing to the swelling of the conjunctiva and its projecting between the lids.

the cornea becomes hazy;* the iris loses its lustre, and sometimes changes in colour; its movements are sluggish, and the pupil is somewhat contracted, as may easily be ascertained when only one eye is affected, by comparing it with the other. Vision is of course impaired to a greater or less degree. Intolerance of light is always present, but varies in amount according to the severity of the other symptoms. The lachrymal secretion is considerable in quantity, and flows periodically from the eye. The pain felt in the globe of the eye is of a stinging, darting character, accompanied with a sensation of fulness and pressure. It extends also to the orbit and forehead, temple, cheek, and generally in the course of the branches of the fifth pair of nerves distributed to the face. The pain is much increased by warmth, and is sometimes of a pulsatory character, or consists, chiefly in an agonizing, wearing-out sensation. It continues till the disease is subdued, varying, however, in degree, increasing in severity towards sunset, attaining its maximum about midnight, and abating towards morning: it entirely prevents sleep, and is a cause of so much distress to the patient, that he never fails particularly to mention it. Along with these symptoms fever is present to a greater or less degree.

Causes. This form of ophthalmia is more rarely met with in children and old persons, than in those of a robust constitution and of middle age, the same exciting causes probably originating at different periods of life different forms of ophthalmia. It may occur in those who have never suffered from rheumatism in other parts of the body, and under any circumstances is said to be always a primary affection, never metastatic. Both eyes are seldom simultaneously attacked; when it does happen, one is generally more seriously affected than the other. Those who have suffered once from this disease, are very liable to be again attacked.

Diagnosis. Besides the diversity of their seats, inflammation of the sclerotic coat is easily distinguished from the corresponding affection of the conjunctiva, by the following diagnostic marks: The redness in inflammation of the sclerotica is deep-seated, and forms a radiated zone around, and upon the margin of the cornea; in that of the conjunctiva it is superficial and reticulated, and frequently accompanied with sub-conjunctival patches of ecchymosis. The secretion from the eye in the former (*scleratitis*) is lachrymal, in the latter it is mucous. The pain attendant upon sclerotica is generally severe, deep-seated, and frequently pulsative; it is especially felt over the orbit, and is aggravated from sunset to sunrise. In inflammation of the conjunctiva, the pain is comparatively slight; it is felt upon the surface of the conjunctiva, imparting a sensation as of sand beneath the eyelid; it seldom extends to the head, and is felt most in the morning when the eyes begin to be moved. In inflammation of the sclerotica there is always intolerance of light, varying in degree according to the severity of the other symptoms; in that of the conjunctiva, though slightly observed in the early stage of the disease, it disappears as the other symptoms become developed. The cornea, moreover, is dull and hazy in the former; in the latter it preserves its natural appearance. If the inflammation has advanced to the iris, symptoms of iritis will be superadded to those already mentioned.

Treatment. Venesection is generally necessary in all cases of rheumatic ophthalmia. With a full strong pulse and a foul tongue, we may take fifteen or twenty ounces of blood, to be followed by the application of leeches in considerable numbers to the forehead or temple. The circumorbital pain is generally

* Sometimes instead of affecting the deepest laminae of the cornea producing this hazy appearance, rheumatismal ophthalmia implicates the more superficial layers, in giving rise to the formation of a small phlyctena which does not appear supplied by the sclerotic vessels, which bursts, leaving a small ulcer; the cicatrix of the ulcer, however, is not productive of opacity, but leaves a small facet cut out of the cornea; the hazy appearance of the cornea ascribed to an extension of the disease to the lining membrane of the eye, is in fact attributable generally, to the involvement of the deeper layers of the cornea itself as is clearly proved by microscopic examination. (Vide *Sichel*, p. 262.) J.

much relieved by the depletion; but should it still continue with a hard pulse, we must repeat the venesection; and this may be several times required before the symptoms entirely yield.

After clearing the bowels with a smart purgative, four grains of calomel and one of opium ought to be given every night, or they may be exhibited in smaller doses at intervals during the day. The effect of this combination in relieving the circumorbital pain is very marked; but as it is not given with a view to produce salivation, we are to be guided in its administration rather by the effect produced upon the disease, than upon the system. It is seldom, however, productive of decided benefit till the mouth is made slightly sore. Occasional laxatives should be administered to obviate the constipating effects of the opium; but active purgatives are to be avoided, as tending to interfere with the due action of the mercurial.

The vinum colchici has been recommended, either alone or in combination with a purgative. If employed singly, it ought to be given in the dose of 3j or 3iss every four or six hours till some decisive effect is observed. When thus exhibited, its effects must be closely watched.

Warm opiate frictions on the temple and forehead are useful in averting or relieving the nocturnal paroxysms of pain. Laudanum alone, or combined with the extract of belladonna, may be used for this purpose, and ought to be applied about an hour previous to the expected occurrence of the attack. Equal parts of laudanum and Tr. Cantharides form a good liniment in chronic cases. Blisters are frequently found beneficial.

The iris should be kept under the influence of belladonna during the whole course of the disease.

Applications to the eye in the form of collyria are of little service; those of a stimulating character are decidedly hurtful in the early stages. Tepid water may be recommended as at least harmless. The vinum opii, either pure or in a diluted state, will be found useful, after the acute inflammatory symptoms have been removed, and little more remains than a lingering redness and morbid irritability of the organ. At this period of the disease, general tonic medicines are sometimes advisable, as small doses of the di-sulphate of quina, or of the mineral acids. Dr. Mackenzie recommends the arsenical solution in old mis-treated cases, in doses of from eight to twelve drops three times daily.

(a) *Catarrho-Rheumatic Ophthalmia.*

To describe this disease merely as a complication of the former with a catarrhal affection of the conjunctiva, would not, in our opinion, be sufficient; its frequent occurrence and the serious organic changes which it often occasions in the structure of the eye, entitle it to a separate consideration.

Symptoms. We have the sandy pain and muco-purulent secretion, characteristic of conjunctival inflammation, co-existing with the circumorbital uneasiness, lachrymal discharge, and intolerance of light observed in scleritis. The latter affection is generally the more severe of the two.

Beneath the reticular arrangement of the conjunctival vessels may be observed the zonular disposition of those appertaining to the sclerotica, at least when not concealed by inflammatory œdema of the sub-mucous cellular tissue, a not unfrequent accompaniment of the acute stage of the disease. The discharge from the inflamed organ is moderate in quantity, and from its compound nature is seldom opaque; imparting a moist appearance and slippery feeling to the palpebræ, the edges of which are generally found adhering in the morning from incrustations of the Meibomian secretion, and their external surface is occasionally red and swollen. The photophobia and lachrymation, which are considerable throughout the course of the disease, become more marked when the inflammation has extended to the structure of the cornea.

Structural changes in the cornea in the form of ulceration, or deposition of pus

in its substance, are what is most to be apprehended; and these are symptoms of such frequent occurrence, that if the disease has been allowed to run on unchecked during eight or ten days, we may expect to meet with one or both of these consequences, especially in patients of advanced years. The ulceration is peculiar in this respect, that it tends to spread over the surface of the cornea, rather than to penetrate deep into its substance. The ulcer is generally of an irregular figure, with a transparent and uneven surface, somewhat resembling an abrasion of the conjunctival covering of the cornea, or as if a portion of its substance had been hacked off with a cutting instrument. The deposition of pus in the substance of the cornea, constituting what is termed *onyx*, is a symptom still more alarming with reference to the eventual preservation of vision. It is usually observed first at the lower edge of the cornea, from whence, gradually extending upwards, it may involve half the diameter of that membrane. The pus thus deposited is rarely absorbed, being generally evacuated externally through an ulcer which forms over its centre.

Very frequently the ulcerative process extends inwards through the posterior layers of the cornea, giving vent to the aqueous humour and producing prolapse of the iris, which terminates in general or partial staphyloma.

Hypopion, or the deposition of pus in the anterior aqueous chamber, is sometimes observed to accompany the formation of *onyx*; or it may result from the contents of the *onyx* being primarily discharged into this cavity through the posterior wall of the cornea, this membrane ultimately giving way through its entire thickness. While these changes of structure are proceeding in the cornea, the iris becomes altered in colour,* and sluggish in its movements; lymph is effused into the pupil, which is now observed to be hazy and contracted, and at last may be entirely closed.

Febrile symptoms indicate the sympathetic affection of the constitution.

Sleep is prevented by the nocturnal accession of pain, and the patient's sufferings are frequently aggravated by the co-existence of catarrhal affections of other portions of the mucous membrane.

Beer attributed rheumatic ophthalmia to the effects of currents of cold air, while he supposed the catarrhal form of the disease to originate from a similar impression of a foul atmosphere. The disease in question may possibly arise from the *co-existence* of these causes, a combination often to be met with in the damp and ill-ventilated dwellings of the poor. The subjects of it are generally persons advanced beyond the meridian of life; it is more rarely observed in the middle-aged or young, and we have never seen it in children.

Treatment. As we have here the co-existence of two distinct diseases, our treatment must be equally of a two-fold nature, being directed both against the sclerotic and conjunctival part of the affection.

With regard to the former, those means must be employed which have already been recommended under the head of rheumatic ophthalmia.

The accompanying conjunctivitis is to be treated by the usual local applications, mentioned under the head of that disease, although it will be prudent to postpone their employment till the acute symptoms of the sclerotic affection have yielded; the gr. iv solution of the nitrate of silver may be dropped into the eye several times daily, or the Vin. Opii either pure or diluted. The red precipitate ointment should be smeared upon the edges of the palpebræ at bed-time, and a solution of gr. j of the Hydrarg Bichlor. in ℥viij of water used tepid, as a collyrium, three or four times a-day.

The rheumatic symptoms are generally the first to yield, the catarrhal per-

* When the iris becomes involved, in addition to the ordinary symptoms of iritis, there is one which is peculiar, and, although not of constant occurrence, may be considered, when it exists, as pathognomonic of rheumatismal or arthritic iritis; viz: an oval form of the pupil, of which the greater diameter corresponds with the vertical axis of the eye. J.

sisting for some days longer; in other instances, the circumorbital pain continues to linger after the conjunctivitis has disappeared.

Dr. Mackenzie dissuades from any attempt being made to evacuate the contents of an onyx by incising the cornea; stating that, in every case in which he has adopted this measure, partial or total staphyloma has resulted. (*Practical Treatise*, p. 488.)*

III. INFLAMMATION OF THE CORNEA.

Inflammation of the cornea, attacking different portions of its tissues, has been already described, as occurring in several of the ophthalmiæ. The disease which we are about to consider is, at its origin, apparently seated in the parenchyma of the cornea, although it gradually spreads to its other tissues, and sometimes even extends throughout the various textures of the eyeball. Occurring generally in

* We cannot conclude the subject of ophthalmia without referring to a peculiar form of this disease, not described by the author, generally connected with visceral derangement, and an obstruction in the venous circulation, and hence designated by the German ophthalmologists as "*abdominal or arthritic or venous ophthalmia*." The character of the injection is in this form pathognomonic, and evidently attributable to a venous congestion of the eye, dependent on a general cause of a like nature. Hence the affection is not confined to the conjunctiva and sclerotica, but bears principally upon those tissues which most abound in the venous capillaries, particularly the choroid and its dependencies.

The conjunctiva presents a few large, almost varicose vessels, bifurcating twice and anastomosing by arcade around the cornea, very distinct when not complicated with catarrhal ophthalmia, but still recognisable, even when this complication exists. Beneath this, and partially masked by it in some cases, is to be seen the specific injection of the sclerotica, composed of vessels forming a zone around the cornea, resembling somewhat the rheumatismal zone, but differing from this latter in being of a deeper colour, *bifurcating and anastomosing before reaching the circumference of the cornea, from which they are separated by a bluish circle*, (arcus arthriticus of Beer—venous circle of Siehel.) This circle, constituting the pathognomonic symptoms to which we wish to direct attention, being probably due to a corresponding engorgement of the canal of Fontana, which canal is in reality a sinus receiving the veins of the iris, and must consequently participate in the general congestion, or due possibly in those cases where the venous circle is incomplete, to an inflammatory swelling of the ciliary body which separates the fibres of the sclerotica in certain points, and renders this membrane so diaphanous, that a change in the colour of the subjacent tissue becomes visible through it. The cornea, as in all cases of affection of the sclerotica, particularly when combined with derangement of the choroid, may offer an interlaminar effusion. This is sometimes followed by a circumscribed, oval ulceration, with irregular edges, which itself often presents a pulvulent or cretaceous appearance prior to its cicatrization.

We have already mentioned that the congestion bore principally upon those tissues most abundantly supplied with veins; in corroboration of this the iris is always affected, and the changes which occur in it *are peculiar*, in addition to the dull, dirty colour ordinarily assumed by this membrane when diseased, its tissue becomes more attenuated, and the pigmentum disappearing in certain points, gives to it a marbled appearance, exhibiting itself in patches of a grayish, bluish, or pearly colour, contrasting with those parts of the iris where the pigmentum is still retained. The pupil also when not adherent to the capsule of the lens is perpendicularly or more frequently transversely oval. But if the iris is affected, so *a fortiori* is the choroid and the consequent disorganization of this membrane, frequently gives rise to a series of symptoms, the mechanism of which is not generally well described by authors, but which constitute a new disease called *Glaucoma*, better designated by the term *Chronic Choroiditis*; the consideration of which will be found in the notes to the chapter on Choroiditis. J.

individuals of a strumous habit, it partakes of the chronic character of scrofulous disease, and seems therefore entitled to the distinctive appellation of *Strumous Corneitis*.

Symptoms. The usual subjects of its attacks are individuals between the ages of eight and eighteen years. It generally commences slowly and insidiously, the cornea loses its natural brilliancy,* and becomes dull and hazy, its surface appearing as if covered with fine dust, or resembling glass which has been breathed upon. In a more advanced stage, attended with increased opacity, the cornea frequently appears covered with minute depressions, such as might be produced by dotting its surface with the point of a pin; sometimes they are of greater depth, resembling under a magnifying lens numerous small ulcers aggregated together. The fine vessels of the conjunctiva and sclerotica become injected with red blood; those of the latter membrane, which is the principal seat of increased vascular action, are arranged in radii round the cornea, and present a carmine hue. The edge of the cornea is sometimes partially encircled by a ring of minute vessels, of a brownish red colour; occasionally they are arranged in patches slightly elevated, with a regularly defined margin, and bearing a close resemblance to spots of ecchymosis. Examined with a strong magnifying power, they are seen to be composed of numerous small vessels, which are straight and parallel with each other. Single vessels are observed to pass over the corneal epidermis and ramify upon it; sometimes they are so numerous as to form a vascular net work covering the entire surface, and giving rise to the appearance which has been named "Pannus."

Besides the general haze of the cornea, there is a marked tendency to the deposition in its substance of an opaque white matter, which is sometimes confined to circumscribed spots, with intervening transparent portions, giving the cornea a mottled appearance. These spots occasionally assume a yellowish hue, as if pus had been deposited; but they rarely ulcerate, and deep ulceration is scarcely ever seen. In other instances the deposition is more general; commencing at the centre it spreads towards the circumference, producing dense opacity of the whole surface, of a uniform dirty white colour. At this stage of the disease, the cornea, when examined laterally, is seen to be increased in volume, and its texture appears as if softened.

Inflammation of the cornea, when of some standing, is usually accompanied with an increased secretion of the aqueous humour, producing a change of figure in the cornea, which becomes more convex than natural. Sometimes the whole globe assumes a somewhat conical form, the thinning of the sclerotica anteriorly permitting it to give way beneath the pressure of the recti muscles; thus constituting, to a certain extent, staphyloma of the corpus ciliare.

Dilatation of the pupil with some degree of amaurosis has been observed. In other cases, the inflammation has spread to the iris, producing contraction of the pupil, and adhesion to the capsule of the lens. From the opaque condition of the cornea, it is frequently very difficult to ascertain the precise state of the internal structures. Much assistance may be derived in such circumstances from dilating the pupil with belladonna, and concentrating the light upon it by means of a large double convex lens.

The intolerance of light is generally moderate in degree, though in some instances it is very great, and accompanied with lachrymation. Considerable pain† with a sense of pressure or tension in the eye, and pain in the forehead, are

* Mackenzie and Velpeau speak of a sea-green colour of the cornea, as attendant upon its inflammation; this appearance is not mentioned by other authors, and its existence is positively denied by Sichel. J.

† When the keratitis is pure and uncomplicated there is neither photophobia nor increased secretion, pain rarely exists, but vision is impaired according to the degree of opacity, from a slight cloudiness to complete blindness; it must be borne in mind that the description above given includes not only simple corneitis but its complications. J.

frequent symptoms in the early stages. The pain is sometimes acute, coming on in paroxysms; but in the chronic state it is slight, especially after the whole cornea has become opaque.

The *prognosis* is rather unfavourable, although from the early age of the patients who are usually the subjects of this affection, surprising recoveries certainly take place.

Treatment. Judging from the apparent chronic character of the inflammation and the trivial amount of pain usually attending it, we might suppose that depletion was seldom indicated; the local abstraction of blood, however, is productive of the best effects in the early stage of the disease. If there be severe pain in the eye and forehead, the propriety of antiphlogistic measures is sufficiently obvious; it may even be necessary to bleed from the arm. The local depletion ought to be repeated occasionally, care being taken not to reduce too much the strength of the patient.

Purgatives and emetics should be employed as recommended under the head of *Strumous Ophthalmia*.

The exhibition of small doses of the potassio-tartrate of antimony, in combination with the di-sulphate of quinia, is highly beneficial, and more effective than either given singly. In cases of moderate severity, the di-sulphate of quinia alone exercises an equally marked, though less speedily developed control, over this disease as it does over scrupulous inflammation of the conjunctiva. In cases accompanied with much general debility, it may be prescribed from the first.

When the symptoms of active inflammation are urgent, and opacity of the cornea is rapidly progressing, these remedies alone cannot be relied upon. Having checked the severity of the inflammatory symptoms, we must have recourse at once to the exhibition of calomel* and opium, so as to affect the mouth; the beneficial operation is evidenced by the contraction, of the dilated corneal vessels, and the gradual absorption of the opaque deposit, the process of clearing beginning at the circumference, and advancing towards the centre. The use of mercury from the first is especially required when the iris participates in the inflammation. Counter-irritation ought not to be neglected, as it is frequently productive of great benefit.

The pain and intolerance of light may be alleviated by the use of warm anodyne fomentations. Stimulating applications to the eye ought on no account to be employed till the acute symptoms have been subdued. When had recourse to, the stimulant ought to be frequently varied; the pupil should be kept under the influence of belladonna, not only when there are evident symptoms of iritis present, but also when its existence is merely suspected. The treatment adopted must be persevered in for a considerable length of time, even although no good effects are immediately observed.

The progress of recovery will be much accelerated by the beneficial influence of pure air and moderate exercise.

Evacuation of the aqueous humour by puncturing the cornea has been proposed as a means of relieving the sense of distention occasioned by the increased secretion of that fluid. The practice is highly recommended by Jünken of Berlin and other continental oculists, also by Mr. Wardrop in this country, who has employed it frequently with advantage in different inflammatory affections of the globe. (*Med. Chir. Trans.*, vol. iv.) Mr. Lawrence, on the other hand, speaks less favourably of the operation.

* The propriety of employing mercury with a view to its constitutional effect in affections of the cornea tending to the disorganization of this membrane is very doubtful; it is absolutely proscribed by Sichel in cases where suppuration may be anticipated, on the very fair grounds that so far from tending to arrest the suppurative process, it actually solicits it by its antiplastic properties. The treatment should be energetically antiphlogistic. J.

IV. INFLAMMATION OF THE IRIS.

We have already had occasion to notice this disease as occurring in the course of several of the ophthalmiæ which have their primary seat in the external tunics of the eyeball. We shall now consider it both as an idiopathic affection, and as it occurs sympathetically, in certain peculiar conditions of the system.

Iritis, from whatever cause it originates, is recognised by certain general indications, some of which it exhibits in common with other ophthalmiæ, and some are peculiar to itself. Among the former may be enumerated: 1. Zonular redness of the sclerotica, composed of numerous vessels surrounding the cornea, and running in parallel radii towards its edge: 2. Adhesions of the iris, and chiefly of its pupillary margin, to the capsule of the lens, and in some rare cases to the posterior surface of the cornea: 3. Effusion of coagulable lymph into the anterior or posterior chambers, and sometimes into both: 4. Imperfection of vision, varying in degree from mere dimness to total blindness: 5. Pain in the eye, and nocturnal circumorbital pain.

Among the latter, or those which may be considered as peculiarly characteristic of iritis, are—1. Loss of brilliancy and change of colour in the iris, from its natural hue to that which might be produced by mingling the colour of the red vessels or the effused lymph with its original tint; thus, a light-coloured iris becomes greenish or yellowish, the blue is converted into a green, or, if dark-coloured, it presents a reddish tinge: 2. Structural change in the iris, manifested by the obliteration of its naturally fibrous texture, and the formation of tubercles or abscesses in its substance: 3. Contraction and immobility of the pupil. The co-existence of these *three* last-mentioned symptoms is pathognomonic of inflammation of the *substance* of the iris only, the *first* and *third* being equally characteristic of inflammation confined to the serous covering of that membrane.

All of the symptoms above-mentioned, in either division, are not invariably present in every single case of iritis: thus, there may be total absence of pain whether in the eye or head, no effusion of lymph, nor any abnormal adhesions, or morbid deposition in the substance of the iris. In some cases complicated with amaurosis, the pupil, instead of being contracted, is dilated; still these are the exceptions: in general, a sufficient number of symptoms is present, to enable us to determine with precision the nature of the disease. As inflammation of the iris may occur in two apparently different structures of the same membrane, viz., the serous covering and the parenchyma or proper substance, it is hence distinguished into “iritis serosa,” and “parenchymatosa.” the former is most frequently observed as attendant upon strumous ophthalmia, the latter in cases of venereal origin.

Iritis may present itself either in an acute or chronic form, to which some authors have added a third, or sub-acute degree. We shall first describe in detail the usual symptoms and effects of acute idiopathic iritis, leaving for after consideration the modifications which it may undergo in degree, and the peculiarities which distinguish it when occurring sympathetically.

(a) *Acute Idiopathic Iritis.*

Symptoms. A vascular, radiated band is formed round the circumference of the cornea, consisting of hair-like, parallel, straight vessels, which terminate abruptly at the edge of this membrane, appearing to sink through the sclerotica as they pass to the iris. The redness is at first confined to the immediate neighbourhood of the cornea, the circumference of the globe being comparatively clear; but as the disease advances, the increased action extends to the vessels of the conjunctiva, the whole surface of the eye assuming a fiery redness which often masks, for a time, the zonular sclerotic injection. The radiated zone continues,

however, so long as the disease lasts, varying in intensity and completeness, according to the degree and extent to which the iris is inflamed.

The naturally brilliant surface of the iris becomes dull and muddy in appearance,* and the beautiful fibrous arrangement of its internal structure is rendered indistinct, or is destroyed; while from the increased vascularity of the membrane or the effusion of lymph, its original hue is exchanged for one of a darker shade. These changes commencing in, and in some instances for a time confined to, the edge of the pupil, gradually extend outwards to the ciliary margin of the iris.

The effusion of coagulable lymph may take place upon either surface of the iris, or into its substance. It may form a thin layer of variable extent upon its anterior surface, producing discolouration, slight irregularity, and a villous appearance of the part; this form of deposit, though generally confined to the *smaller* circle of the iris, is attended with dimness and change of colour of the annulus major.

The lymph is sometimes deposited in masses of a reddish yellow colour, varying both in size and number, and seated at the edge of the pupil, or upon any part of the anterior surface of the iris. Sometimes it is so profuse in quantity as to fill the anterior chamber.

Suppuration and true abscess of the iris may occur. The membrane appears to swell, and bulges forward towards the cornea, becoming puckered and irregular; one or more minute yellowish points appear upon its surface, indicating the seat of the abscess, which bursts, and pours its contents into the anterior chamber, forming hypopion. The shreds of the cyst are often visible for some days hanging from the surface of the iris. Hypopion may also occur from direct effusion of lymph, sometimes mingled with blood, into the anterior chamber. Effusion of lymph may also take place upon the posterior surface of the iris or uvea, and upon the margin of the pupil, in the former case uniting the iris to the anterior capsule of the lens, in the latter obscuring the natural transparency of the pupil by the intervention of a thin film of lymph, or even completely blocking it up with an opaque mass.

Lymph may be effused in such quantity into the posterior chamber as to make its way through the pupil, or produce tumour of the sclerotica, or even pass through that coat and protrude beneath the conjunctiva. From the yellowish appearance of the tumour thus occasioned, such cases have been mistaken for examples of general suppuration of the globe; a consequence which Mr. Lawrence remarks he has never observed to result from iritis in any form. (*Op. Cit.* p. 287.)

Effusion into the substance of the iris, with discolouration of this membrane and thickening of the pupillary margin, are generally the first changes observed, and usually occur together; but in very violent cases, effusion of lymph may take place simultaneously in each of the situations indicated. The movements of the iris, which at first are rendered sluggish and limited by the interstitial effusion, become at last wholly suspended; an effect which is farther promoted by the existence of abnormal adhesions. The pupil is observed to contract as the disease advances, to become dull, cloudy, and irregular, and sometimes altered in situation from the causes just mentioned. Its edge is thickened and retracted towards the capsule of the lens, and presents a villous or spongy appearance. As many morbid phenomena tend to prove the existence of an intimate vascular connexion

* In simple serous iritis, the fundamental colour of the iris is not changed, but is modified by the interposition of a pale grayish coat, which gives a dull appearance to the membrane; while in simple parenchymatous iritis, the fundamental colour is absolutely changed for another colour. Thus, in serous iritis a blue iris remains blue, and a brown iris remains brown; but the colour in both remains dull: while in parenchymatous iritis, a blue iris becomes green, and a brown iris, reddish.

between the sclerotica, cornea, and iris, we are not surprised to find haziness of the cornea, which is at first general and slight; but if the inflammation is severe, or of long continuance, circumscribed capacities of greater density may be formed.

Pain is rather a variable symptom: sometimes it is of a burning tensive character, felt deep in the globe and over the orbit, extending also to the bones of the temple and cheek; it is aggravated during the night, and totally prevents sleep. In other instances it is slight, or entirely absent, even in cases attended with extensive disorganization. Dimness of sight is an early consequence of iritis, and may be gradually increased, until a mere perception of light and shadow remains.

In very acute cases there is a considerable degree of fever present, which, however, is variable. If not checked, the inflammation gradually spreads from the pupillary margin of the iris to its external border, and from thence to the corpus ciliare, and the deeper-seated structures of the choroid and retina, attended with great increase of the local suffering, and marked by the sensation of flashes of light, and the gradual extinction of the power of vision. The inflammatory action also extends to the cornea and other external tunics, until at last it may involve every tissue of the eyeball.

The structural changes most frequently observed are the following: the iris presenting a dull leaden hue, and completely altered in structure, bulges forward in the form of a convex protuberance with a puckered surface, the result either of thickening of its texture or the pressure of an increased secretion behind it. The cornea is either clear, or opaque in various degrees, and vision is irrecoverably lost, as inflammation capable of effecting such alterations of structure generally extends to the retina. The pupillary margin of the iris may be attached by various points of its circumference to the capsule of the lens by means of slender threads of lymph, which however admit of some degree of motion. Alteration of the pupil in figure does not interfere with perfect vision; and even its reduction in size to a mere pin-hole is not productive of any material inconvenience provided it is clear. In some instances, the pupil is entirely closed, and the iris adherent to an opaque mass of lymph which has been effused behind it, producing the condition termed "*atresia iridis perfecta*," in which case vision is lost. In other instances we find the pupil still open and only partially occupied by the effused lymph, which may be situated either in the centre of the aperture, leaving the iris free, or on one side with the iris adhering to it, and producing displacement of the pupil from its natural position. This has been termed "*atresia iridis imperfecta*:" vision is impaired to a greater or less degree, but is often susceptible of improvement by the use of belladonna to dilate the pupil. If lymph has been effused to such an extent as to cause tumours of the sclerotica, although it may be absorbed as the inflammation declines, the internal structures have generally suffered so much injury that the globe becomes flaccid and atrophic.

For some time after the disease has ceased, and especially if the attack has been severe and protracted from mismanagement, the eye continues weak, morbidly sensitive to external influences, and prone to relapse from slight exciting causes.

Iritis may present itself in a *chronic* form, arising imperceptibly and attended with so little pain and redness, as not to attract the patient's attention, and yet proceeding by the effusion of lymph to the gradual diminution, or even total destruction of vision. If confined to one eye the injury may only be discovered accidentally, by the patient closing the sound one. Between this very obscure form of the disease, and the severe and well-marked affection which we have already described, various degrees may be observed, varying in the prominence of their symptoms, the amount of injury which they inflict, and the facility with which they yield to treatment.

Causes. Among these may be enumerated direct injuries to the eye, whether occurring accidentally or inflicted during the performance of surgical operations, as in the extract of cataract, or the formation of artificial pupil. Over-exertion of

the eyes, or atmospherical influences, are sufficient to give rise to this disease in some individuals, especially in those of strumous habit, or who exhibit that unhealthy condition of the system observed in gout, rheumatism, or secondary syphilitic affections. The occurrence of iritis has been ascribed by some writers, either wholly or in part, to the use of mercury. That its undue employment may predispose an individual to iritis, as well as to inflammatory affections of other textures, may be admitted; while we are far from thinking that there is sufficient evidence to establish the relation of cause and effect between the judicious use of this medicine and the disease in question. Mr. Lawrence (*Treatise on the Venereal Diseases of the Eye*, p. 165,) remarks that he has seen no instance of iritis of any kind, in which there appeared to him reason for ascribing the complaint to this cause. A similar testimony is given by Mr. Rose, Dr. John Thomson, and Dr. Eckerström of Stockholm, as quoted by Mr. Lawrence.

Diagnosis. The rheumatic and catarrho-rheumatic forms of ophthalmia and iritis may be confounded with each other; and indeed the former diseases are seldom observed to exist without the latter being present in some degree. The mistake would not however be of much importance at first as regards treatment, similar and equally active measures being required in the same form of each of these affections. From corneitis, with which it has several symptoms in common, it may be distinguished by the opacity of the cornea, which exists to a much greater degree in the former affection than is ever observed in iritis, presenting a peculiar mottled and striated appearance, with red vessels occasionally ramifying upon its surface. The state of the iris and pupil, when it can be ascertained, will frequently assist us in deciding upon the individual or combined existence of these diseases. If the pupil is of the natural size, and the motions of the iris free, the case is one of simple corneitis; if on the other hand, the pupil is contracted and fixed, iritis is undoubtedly present.

Retinitis exhibits the same appearance of external inflammation and gradual closure of the pupil observed in iritis, but is more sudden in its attack, and runs its course with greater rapidity; the local suffering is more intense, and vision in every degree is extinguished at an earlier period of the disease.

Recovery may be considered hopeless, when along with change of colour in the whole iris, and a contracted and opaque pupil, there is great external vascularity, severe, deep-seated pain, and total insensibility to light.

Treatment. To subdue the inflammatory action, to arrest the effusion of lymph and promote the absorption of what has been already deposited, and to preserve the natural condition of the pupil, are the three principal indications to be fulfilled in the treatment of this disease. We must seek to accomplish them by the employment of antiphlogistic measures, mercury and belladonna.

General and local depletion must be at once resorted to, and pursued with vigour, when there is reason to apprehend an extension of the inflammation from the iris to the deeper tissues of the eye. The blood-letting should be repeated till the disease gives way. The bowels must be freely moved by mercurial purgatives followed by saline aperients, the potassio-tartrate of antimony in nauseating doses, low diet and rest, not merely of the inflamed organ, but of the *whole body*—a circumstance of much importance in the treatment of the internal ophthalmia.

In cases of less severity, the local abstraction of blood by leeches and cupping will probably suffice; although venesection is often to be recommended, even when the disease does not present a very acute character. Having thus arrested the inflammatory action, we must proceed at once to the exhibition of mercury; without which we shall rarely succeed in checking, and still less in removing, those alterations of structure, which result from the deposition of lymph in the pupil and texture of the iris. The best form, generally speaking, is that of calomel with opium, in the proportion of from gr. ij to gr. iv of the former, with from gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$ or more, of the latter, every eight, six or four hours as the case may require.

With regard to the extent to which the employment of mercury should be carried, it is in general sufficient to affect the mouth. In some cases full salivation rapidly produced, acts like a charm in carrying off the disease; the medicine may then be intermitted and its effects allowed to subside. In cases of a chronic character, it is generally necessary to keep up a moderate degree of mercurial action for some time; this is more frequently required in relapses, and cases where the patient has been previously affected, than in first attacks. The question has been frequently discussed, whether iritis can be cured without mercury, and variously replied to: we have no hesitation in saying that it can; but it is much more likely in such circumstances to prove injurious to vision, from the persistence of those structural changes which this medicine only is adequate to remove.

As regards the sufficiency of mercury when employed alone, to effect the cure of iritis, it is no doubt possible, and the disease has frequently been thus treated; but generally speaking, the practice is not to be recommended, and the exhibition of mercury unpreceded or accompanied by depletion has unquestionably been productive of serious injury to the affected organ. Mr. Lawrence states, that "iritis generally, and the syphilitic form of the complaint particularly, will be most advantageously treated by the successive or combined employment of antiphlogistic means and mercury; that this plan will give the quickest relief, will most effectually arrest the inflammation, restoring the iris to its healthy structure and functions, and will afford the best security against the return of the disease." (*Op. cit.*, p. 307.) The exhibition of mercury will often prove beneficial even after every symptom of active inflammation has passed away, and those effects alone remain, which we might suppose to be permanent; in such circumstances, its action ought to be slowly excited and maintained during several weeks. Mercury has also been employed locally, to relieve the circumorbital pain, which is frequently productive of so much suffering. For this purpose, from gr. viij to gr. x of the Ung. Hydr. Fort. combined with gr. ij or more of powdered opium, ought to be well rubbed into the temple or forehead at night, previous to the occurrence of the paroxysm.

To prevent the contraction of the pupil, the extract of belladonna should be smeared over the eyebrow once in the twenty-four hours. The employment of belladonna in this manner, during the acute stage of iritis, has been objected to, from its occasional effect in tearing asunder the adhesions between the iris and capsule of the lens, leaving portions of the uvea permanently fixed upon the capsule although it cannot be denied that this does sometimes happen, it will be of rare occurrence if suitable depletory measures have been premised. When the acute inflammatory symptoms are removed, a filtered aqueous solution dropped upon the conjunctiva may be substituted for the extract applied to the skin. The continued use of this remedy in one or other form, even for months, is frequently advantageous, producing gradual dilatation of the contracted pupil, and elongation of the filaments of lymph which bind the iris to the capsule of the lens.

Counter-irritation by blisters, though not admissible in the acute stage of the disease, is of essential service at a later period. Local applications in the form of collyria are unnecessary; those of a tepid soothing nature are productive of little benefit, and stimulating washes are decidedly injurious while any acute symptoms remain. Mr. Carmichael of Dublin has recommended oil of turpentine as a remedy in iritis; he was led to employ it from the observation of its good effects in peritonitis, in which a membrane, presenting some analogies both in its healthy and morbid conditions to the iris, is the seat of inflammation. It is not proposed as a general substitute for mercury, but as an active and effectual remedy, applicable in circumstances in which from idiosyncrasy, debility, or other causes, the former is inadmissible. He employs the following formula:—*R.* Ol. Terebinth. Rectif. 3j; Vitell. Unius Ovi; tere sinul, et adde gradatim Mist. Amygd. 3iv; Syrupi Aurantii 3ij; Tr. Lavand. Comp. 3iv; Ol. Cinnamomi gtt. iij vel iv. Misce. Sumant coch. magna ij ter in die. Mr. Guthrie reports favourably of its effects in some instances.

while in others it was either of little service, or completely failed. Mr. Lawrence has had no experience of it; and although we have not given it a fair trial, we should advise its employment in cases in which the use of mercury is contra-indicated.

(b) *Syphilitic Iritis.*

The iritis which occurs in a constitution infected with the venereal poison, is a sympathetic affection, which closely resembles the idiopathic form in its leading features, and yet differs from it in presenting some peculiarities. It is the most frequent form of iritis, and a secondary symptom of the venereal infection as distinctly marked as any other. It sometimes occurs alone, but more frequently presents itself in combination with other morbid evidences of the constitutional taint; and like other members of the family of early secondary symptoms, may appear before the *primary* disorder is cured. Conformably to the cause of syphilitic affections in general, it is slow and insidious in its early stages, but as it is developed, may prove rapidly and extensively destructive. It is rarely observed as a symptom of syphilis in infants. Mr. Lawrence, whose experience in this disease has been very great, says, that only two instances of the kind have come under his observation. (*Op. cit.*, p. 317.)

Syphilitic iritis may occur either in an acute or chronic form, is distinguished in these different degrees by the general symptoms already enumerated. Two circumstances have been mentioned, as peculiarly characteristic of the syphilitic form of the affection,—viz. displacement of the pupil, upwards and inwards, towards the root of the nose; and the effusion of lymph in masses, or in the form of tubercles, upon the surface of the iris. With regard to the first phenomenon, its occurrence appears to be accidental, and may be referred to the peculiar position of the adhesions between the pupillary margin of the iris and the capsule of the lens. Dr. Mackenzie attributes it to an affection of the ciliary or iridal nerves, and states that he has observed it to occur in chronic rheumatic iritis, and still more frequently in choroiditis, unattended by inflammation of the iris. (*Op. cit.*, p. 513.) Tubercles upon the iris are certainly rare to be met with, except in syphilitic cases; they are of a reddish brown colour, with an irregular surface, and may grow from any part of the membrane, sometimes attaining such a size as to compress it and fill the anterior chamber. They ultimately suppurate, pouring their contents into this cavity; and from the pupillary margin being generally adherent in such circumstances to the anterior capsule of the lens, the gradual contraction of the remaining cyst may detach the iris from the ciliary ligament, or cause laceration or absorption of its fibres, thus producing a permanent false pupil. In addition to the above circumstances, a cinnamon colour of the sclerotic zone, minute brown spots upon the cornea, and nocturnal circumorbital pain, have been mentioned as diagnostic distinctions of syphilitic iritis; they are certainly corroborating evidences when taken in conjunction with other symptoms, but are not peculiar to this form of inflammation.

Diagnosis. There is no single symptom which can be relied upon as pathognomonic of syphilitic iritis; but in the generality of cases its existence may be clearly inferred from the combination of several, taken in connexion with the previous occurrence or actual presence of syphilitic affections in other parts of the body. Mr. Lawrence observes, “although the effusion of reddish, brownish, or brownish-yellow lymph on the iris in the adult, clearly shows the case to be venereal, I have seen analogous appearances in several instances both of young children and infants, in whom no suspicion of syphilis could be entertained. (*Op. cit.*, p. 319.)

The *treatment* already recommended under the head of *Idiopathic Iritis* is equally applicable to the syphilitic variety.

(c) *Rheumatic Iritis.*

Judging from the descriptions which have been given of this disease, and we especially refer to that of Dr. Mackenzie (*op. cit.*, p. 505. *et seq.*), we are unable to discover wherein it essentially differs from idiopathic iritis. It is apparently the same in its symptoms, mode of progress and effects; is produced by many similar causes, and yields to the same mode of treatment. The distinction which might be drawn from the circumstance of its occurrence with an unsound condition of the system, is one which does not always hold good, as it may occur in individuals who have never exhibited any other evidence of their possessing a rheumatic diathesis. Like rheumatic affections in general, this form of iritis is said to be frequently excited by atmospherical changes, and is very apt to renew its attack; it has not been observed to be metastatic.

The modifications of *treatment* which have been recommended apply chiefly to the minor details, and do not at all affect the general principles already laid down. The di-sulphate of quinia is frequently beneficial, but ought by no means to be relied upon singly, and still less ought it to supersede the exhibition of calomel and opium, in the circumstances and manner already noticed under the head of idiopathic iritis. The patient ought to be especially careful against exposing himself to sudden alterations of temperature. Dry warmth, applied to the eye by means of compresses of old linen heated at the fire, is frequently productive of benefit, and tepid fomentations with some narcotic decoction, as poppy-heads, belladonna, or tobacco, may be employed; the parts being afterwards carefully dried and the heated compress replaced. Counter-irritation is especially useful; this may be effected in a minor degree, by adding an equal quantity of the Tinct. Lyttæ to the laudanum with which the temples are rubbed. Vin. Opii dropped into the eyes is useful in the decline of the disease.

(d) *Arthritic Iritis.*

The arthritic inflammation of the Germans, whether identical or not with the gouty inflammation, properly so called, as observed in this country, does not manifest itself exclusively in the first or plethoric period of gout, when the patient's digestive powers continue unimpaired; but occurs equally, and perhaps more frequently, "in the second or asthenic period of the disease, when repeated attacks have produced debility and dyspepsia." (Mackenzie, *op. cit.*, p. 527.) Although the disease we are about to describe originates in and is limited to the iris, it is also developed in the sequel of a more extended and destructive inflammatory condition of the internal textures of the eyeball, apparently of a gouty character.*

Arthritic iritis generally presents itself in an acute form, and exhibits the usual objective symptoms of inflammation of that membrane; distinguished, however, by several peculiarities: thus, the sclerotic redness is of a purplish hue, and the vessels composing it stop short within a line or so of the margin of the cornea, the intervening space being occupied by a narrow ring of a bluish white colour, which is sometimes incomplete, being developed only towards the angles of the eye. The sclerotica itself presents a dirty grayish violet colour, while the visible blood-vessels passing across it from the recti muscles are frequently varicous. The palpebræ are red and slightly swollen, and small masses of a whitish foam are observed to collect upon their edges and at the inner canthus. As the disease advances, the iris begins to exhibit symptoms of change of structure, becoming

* This general morbid condition Beer includes under the head of "Arthritic Iritis;" while Mr. Lawrence, more correctly in our opinion, describes it under the title of "Arthritic Inflammation of the internal Tunics," of which the iritic affection is only one of many consequences.—AUTHOR.

dull and discoloured: the pupil retains its natural position, but is contracted, and the iris is united by one or more points of adhesion to the capsule of the lens; there is considerable intolerance of light and lachrymation. The pain, which is sometimes the earliest symptom, is at first of a peculiar tingling character, felt in the neighbourhood of the eye and upon the integuments of the face; but extending by degrees to the eye and orbit, the side of the head, and the jaw, it becomes proportionally increased in severity. The pain is frequently periodical in its attacks, but is always aggravated during the night; the constitutional symptoms are of a febrile character and vision is considerably impaired. After having continued for some time, the disease may gradually decline, the symptoms wholly disappear, and vision be completely restored, although the iris remains united by whitish adhesions to the capsule of the lens. The inflammation is very prone to return, and such relapses may occur frequently without occasioning any serious injury to the organ. But as effusion of lymph takes place during each attack, the pupil in general is gradually contracted, and at last entirely filled with an opaque adventitious membrane, sight being wholly lost, although the texture of the iris may have undergone but slight alteration. The pupil is sometimes closed by one severe attack, or contracted and filled with a densely opaque mass. Arthritic inflammation, when severe and long-continued, may produce complete disorganization, with puckering and tubercular projection of the iris, and extinction of sight.

Causes. The disease in question appears to arise spontaneously, without any assignable cause besides that which exists in the state of the constitution, and perhaps in the condition of the digestive organs. In such circumstances, the ordinary ophthalmiæ are apt to degenerate into this form.

Treatment. We shall notice the treatment only in so far as it differs from that recommended under the head of *Idiopathic Iritis*. However objected to by some writers, apparently on speculative grounds, we need not hesitate to deplete, both generally and locally, in robust and plethoric individuals; and even in older persons, whose strength has been reduced by previous gouty attacks, the abstraction of blood is apparently equally necessary, when active local disease is combined with much febrile action. After depletion and the exhibition of mercurial purgatives, the Tr. of Colchicum may be given with advantage, either alone or combined with a purgative. Although the employment of mercury, to the extent of producing salivation, is neither necessary nor beneficial, an alterative course may be prescribed with much advantage, and continued in some cases during weeks or months. The sesquioxide of iron has been given with benefit in some cases, in which depletion and mercury had been employed without advantage. The di-sulphate of quinia, in combination with Fowler's solution, is also worthy of a trial.

Abstinence from stimulating articles of food and drink ought to be enjoined. Counter-irritation is of great service after the urgent inflammatory symptoms have been subdued. Tepid anodyne fomentations, or preferably, dry warmth as recommended in the preceding section, are the best local applications. Friction with opiates upon the temple and forehead will moderate the severity of the periodical attacks of pain, and ought to be employed every evening previous to the time of their expected recurrence. To correct the relaxed and weakened condition of the blood-vessels of the eye, and remove the preternatural sensibility which generally remains after the acute inflammatory symptoms have disappeared, we may employ some local tonic. The Germans recommend for this purpose wearing over the eye small linen bags filled with dried aromatic plants; probably the gentle stimulus communicated by the exhalation of their volatile particles may be of service. Friction round the orbit with some stimulating fluid has been employed beneficially with the same design, and even stimulating applications to the conjunctival surface itself. But of one and all of these local remedies it may be remarked, that we must be cautious in having recourse to them, while any inflammatory symptom continues to linger in the affected organ.

(e) *Strumous Iritis.*

Strumous iritis is sometimes observed to exist as a primary affection, but much more frequently occurs in consequence of the extension of this kind of inflammation from the external tunics to the deeper textures of the eyeball. Occurring generally in a chronic form, with mild symptoms, and being preceded and accompanied by structural changes in the cornea which obscure our view of the internal parts, its existence may be entirely unsuspected. After continuing for a length of time without making much progress, it may ultimately extend and produce disorganization of the neighbouring tissues, terminating in amaurosis and atrophy of the globe. Iritis occurring in very young persons may always be suspected as of this character, from the comparative rarity of its other forms at this period of life. Like strumous inflammation of the external tunics, it is an obstinate affection, and less amenable to treatment than the other species of iritis.

The *treatment*, with the exception of certain modifications suited to the peculiar nature and seat of the disease, as the omission of local stimuli, and the application of belladonna to the eyebrow, does not differ in any essential particular from that recommended under the head of *Strumous Ophthalmia*.

V. INFLAMMATION OF THE RETINA.

Simple idiopathic retinitis is comparatively a rare disease, at least in this country, although as a sympathetic affection it frequently occurs in the course of other ophthalmiæ, whether external or internal.

From the peculiar position of the retina, by which it is concealed from immediate observation, as well as from its functional importance, the symptoms by which we are enabled to recognise retinitis are chiefly of a physiological character. There is acute deep-seated pain in the globe extending to the eye-brow, great intolerance of light, and the appearance of shining spectra of various forms, with gradual diminution of the power of vision. The iris is motionless, and the pupil greatly contracted, while the whole globe is exceedingly sensible to the slightest touch or movement. All of these symptoms are frequently developed, before a dull general redness of the sclerotica makes its appearance. The disease is attended with great febrile excitement; and the excessive pain of the eye and head is frequently followed by delirium and other symptoms of phrenitis; for which indeed it may be mistaken, as the characteristic symptoms of the ophthalmia are not always very obvious. Acute retinitis is rapid in its progress, and tends, if neglected, to pass into general inflammation of the internal textures, accompanied with photopsia, chemosis of the conjunctiva, discolouration of the iris, deposition of coagulable lymph in the pupil, and finally purulent effusion into the anterior chamber, which may increase to such an extent as to cause rupture of the cornea, and destruction of the eyeball.

Chronic inflammation of the retina, or as it is vulgarly termed "weakness of sight," is an affection much more frequently to be met with than the acute form of the disease above described. It is characterized by intolerance of light varying in degree, imperfection of vision, the appearance of "*muscæ volitantes*:" and other ocular spectra, and a sensation of dryness in the mucous membrane of the eyes and nostrils; by degrees the pupil becomes contracted, and the iris motionless. Morbid sensibility of the parts supplied by the fifth pair of nerves is sometimes observed to accompany this disease; thus the slightest touch in the neighbourhood of the eye is followed by pain of some duration.

Causes. Acute retinitis may be produced by sudden and vivid flashes of light, or by exposure to the continued influence of light and heat, as from large fires: hence it is frequently met with in cooks, and certain classes of artisans whose occupations necessarily subject them to these stimuli. Reflected light seems to be

more pernicious to the retina than that which falls upon it directly from a luminous object; hence the deleterious effects of the glare from snow in northern regions, or from the burning sands of southern latitudes. Simple retinitis, however severe, does not usually pass into general inflammation of the globe unless from neglect, or when it occurs in individuals specially predisposed from some peculiarity of constitution, or accidental condition of the system.

The *chronic form* of the disease is generally observed in persons whose occupations require continued exercise of the eyes upon minute objects, whether brightly or imperfectly illuminated;* for in either case the eye is overstrained, though the *modus operandi* of the exciting cause may be different. Thus watch-makers, tailors, milliners, engravers, printers, and those who fatigue their eyes much in reading and writing by artificial light, are frequently the subjects of this affection. Probably the constrained and stooping posture required in these and some other trades, may contribute to its occurrence, by inducing a congested condition of the vessels of the head. It is not unfrequently met with in those addicted to the excessive use of ardent spirits, and perhaps from the reason just mentioned. Onanism has also been assigned as a cause, whether justly or not we cannot say.

Diagnosis. Occurring in a chronic form it is very apt to puzzle the younger practitioner, who is frequently misled by the patient's complaints of "weakness of sight," to apply stimulants when he ought to deplete. The history of the origin and progress of the complaint, taken in connexion with the temperament of the patient and his habits of life, will in general suffice to clear up the diagnosis. In all doubtful cases, great caution ought to be shown in the employment of stimuli, whether general or local.

Treatment. Copious blood-letting is to be employed, followed by the application of leeches round the eye in considerable numbers, till the inflammatory symptoms are relieved. After clearing the bowels, calomel and opium should be given so as rapidly to affect the mouth. (See cases related by Mr. Lawrence, ch. xviii. of *Treatise*, p. 323.) The extract of belladonna ought to be smeared over the eyebrow, and perfect rest both of the body and of the eyes must be enjoined, with abstinence and the exclusion of light. Counter-irritation may be had recourse to after the employment of more effective remedies. If general inflammation of the globe takes place with suppuration, a poultice is to be applied; but the cornea is not to be opened while the contained pus is small in quantity, as it may possibly be absorbed under the combined influence of mercury and counter-irritation. Beer recommends the repeated application of the *vinum opii* to the eye in this condition, and states that under the use of this remedy, along with the exhibition of opium and sometimes cinchona, he has witnessed the complete disappearance of depositions of pus in the anterior chamber. Should the matter collect in such quantity as to fill the anterior chamber, or be accumulated at a greater distance from the surface, it must be evacuated by incising the cornea with an extraction knife, or by making a section of the sclerótica parallel to, and a little behind, the edge of the cornea. In these circumstances the natural appearance and structure of the eyeball are destroyed, and it becomes either flattened anteriorly or staphylomatous.

With regard to the treatment of retinitis in its *chronic form*—avoiding the use of all stimulant applications, we must have recourse to moderate depletion by leeching, which may be repeated as the occasion demands, along with the exhibition of purgatives and the moderate use of mercury and counter-irritation. The eyes ought to be shaded from the light, and exposure to the exciting causes of the disease as much as possible avoided. Inattention to this last named and apparently very obvious particular, either from neglect or necessity, is frequently an occasion of the protraction of the disease, despite of the most judicious treatment.

* Tailors frequently complain of dark-coloured work as being especially injurious to the eyes.—AUTHOR.

VI. INFLAMMATION OF THE CHOROID.

Inflammation of the choroid (*choroiditis*) is minutely described by Dr. Mackenzie as an independent disease, while Mr. Lawrence regards it rather as one link in a chain of morbid effects resulting from general inflammation of the internal tunics. Although the inflammatory action in its early stages may possibly be limited to the texture of the choroid, it speedily extends to the neighbouring tissues, producing various forms of disorganization by which the disease is recognised rather than by any sign of vascular action.

One of the earliest objective symptoms is the formation of a blue zone round the cornea, of variable breadth and completeness, produced by thinning of the sclerotica, which is succeeded by the protrusion of small tumours of a dark bluish colour, and varying in number, size, and position. A watery effusion is gradually formed between the choroid and retina, producing absorption of the vitreous humour, and compressing the latter membrane into a cord-like substance, which simulates the appearance of deep-seated cataract or malignant tumour of the optic nerve.

Changes in the pupil are frequently observed, consisting in displacement, contraction or dilatation, and immobility, with narrowing of the iris towards the affected portion of choroid. The cornea presents opacities of various forms and degree; from which cause alone vision may be materially impaired.

Great enlargement of the globe sometimes succeeds to these changes, followed by inflammation and suppuration, or fungous growths, rendering the extirpation of the organ necessary. The disease is generally attended with considerable pain and intolerance of light, and the appearance of various morbid and optical phenomena referrible to the condition of the retina or the neighbouring tissues. In some cases these symptoms afford the earliest indications of the disease. Blindness may ensue before the disease has apparently made much progress; and on the other hand there may be enlargement and discolouration of the whole globe with tolerable vision. The constitutional symptoms are inconsiderable, especially in the early stages; but the digestive organs are frequently deranged from the first.

The *causes* of choroiditis are involved in much obscurity; those to which it has been referred are equally productive of other forms of ophthalmia. It is a disease of adult years, more frequent in females than in males, and in those of a strumous habit than the reverse. In children it occurs only as a consequence of injury.

The *treatment* consists in the employment of profuse and repeated blood-letting, both general and local, in the early stages, with the use of mercury, in the first instance as a purgative, and afterwards as an alterative. The continuance of the medicine till the mouth is affected, does not appear to be productive of any decided benefit. The warm bath will be found of much service, and tonics are sometimes productive of benefit after depletion. The arsenite of potass has been recommended as exerting a marked influence over several of the symptoms; it may be given in the dose of $\frac{1}{32}$ of a grain thrice daily, and gradually increased. Counter-irritation by means of the tartar-emetic eruption is useful. Puncture of the sclerotica and choroid to evacuate the contained fluid, may be resorted to when there is a tendency to choroid staphyloma; it generally relieves the sensation of tension and pressure in the eye, and may be repeated weekly, or at longer intervals. A choroid staphyloma sometimes requires to be removed, from the inconvenience occasioned by its size and prominence; the most projecting portion is generally cut away, and the rest of the eyeball left.

VII. INFLAMMATION OF THE LINING MEMBRANE OF THE AQUEOUS CHAMBER,
AND OF THE LENS AND ITS CAPSULE.

These diseases having been described by different writers upon ophthalmology, demand only a passing notice. They are of rare occurrence, and the latter affection at least little amenable to treatment; they are consequently comparatively unimportant; and from the difficulties attending the diagnosis, they are not likely to be recognised, unless by those who have made the diseases of the eye a special object of study. It is therefore sufficient to refer to the works of Wardrop (*Morbid Anatomy of the Human Eye*, 2d edit. vol. ii. p. 6,) Mackenzie (*Practical Treatise*, 2d edit. p. 552,) and Walther (essay on *The Diseases of the Crystalline Lens, and the Formation of Cataract*, in his *Abhandlungen aus dem Gebiete der Praktischen Medicin*. Landshut, 1810,) for a detailed account of these affections.

A M A U R O S I S.

Definition.—Idiopathic and symptomatic.—Symptoms.—Causes.—Diagnosis.—Prognosis.—Treatment.

The term Amaurosis (derived from *αμαυρω*, to obscure or darken,) is applied to those diseases of the eye in which there is partial or complete loss of vision from impaired sensibility of the retina. It is synonymous with *gutta serena*, which has been given to the disease from the erroneous idea, that the enlarged pupil which is often one of its symptoms, is a dark fluid that intercepts the rays of light: hence also the name *cataracta nigra*. Amblyopia (from *αμελος*, dull; and *οψις*, vision) is applied to the slighter forms of the disease, in which, though objects can be seen, they are imperfectly distinguished. Some writers describe, as a complicated form of this disease, various structural changes of the internal textures of the globe, which ultimately affect the retina, and in which, therefore, impaired vision or total loss of sight occurs as a symptom: but we agree with Mr. Lawrence in deeming it better to limit the term of amaurosis to the instances in which the disease has commenced in, and been originally confined to, the nervous structure. (*Treatise on the Dis. of the Eye*, p. 490.) Much confusion has been produced by the indiscriminate and inaccurate use of the terms functional and organic, which when thus opposed to each other, as if expressive of two distinct and essentially different conditions of disease, are far from conveying any clear or definite ideas. The following remarks of Mr. Lawrence upon this point are so pertinent, that we quote them at length: "The state of an organ necessary to the correct execution of its function, is a living not a dead condition; it requires not merely a certain organization as we find it after death, but a supply of healthy blood in a certain quantity, a natural state of nervous influence and sympathy, and perhaps other circumstances not clearly understood." "If all these conditions are combined, can we consider it possible that the function should be disordered or interrupted? If one or more should be altered or wanting, can the disease be properly regarded as simply functional?" "Since then the epithets organic and functional are indefinite, being employed in different senses by different persons; since they do not denote generally well ascertained and clearly understood conditions of parts; and since the situation of the nervous apparatus of sight renders it impossible for us to know its exact state in most instances, I consider this distinction of amaurosis to be of no practical utility, but from its vagueness rather calculated to mislead." (*Op cit.*, pp. 489–90,) while agreeing fully with these observations, we would not be misunderstood as denying the *principle* contained in the distinctions above referred to, however we may question the propriety of the mode in which it has been applied.

Looking at the amaurotic affections generally, two great classes into which they naturally divide themselves are clearly distinguishable;—viz., those dependent upon *primary* disease of some portion of nervous apparatus of vision, as the retina, optic nerve or brain; and those arising *secondarily* and sympathetically from disease in other, and perhaps distant parts of the system. To the former of these classes, the name of the *idiopathic* may be given; to the latter, that of the *sympathetic* or *symptomatic*. We do not enter upon a consideration of the analo-

gies or differences in the actual condition of the visual structures in these two classes of disease, inasmuch as such an attempt would be in a great measure conjectural, nor do we affirm that the line of demarcation can, in every case, be clearly drawn between them; but, generally speaking, they are sufficiently discriminated from each other by the differences in their symptoms, the nature of the prognosis which they suggest, and the treatment which they demand. Dissociated from names which only tend to mislead, we consider the distinction to be of great practical utility, and propose to adopt it in the sequel of this paper.

With reference to its duration, amaurosis has been divided into the incipient or recent, and the inveterate or confirmed. In degree, it may be partial or imperfect, and complete;* while in regard to persistence, it has been distinguished as continued and intermittent, the latter being periodical or irregular. Amaurosis is said to affect females, more frequently than males, and dark-coloured eyes rather than the lighter shades. The disease may attack one or both eyes; in the former case, generally extending after a time to the other also; and in the latter instance, presenting differences in degree in each organ.

Symptoms. In detailing generally the symptoms, whether of idiopathic or sympathetic amaurosis, we shall arrange them under the heads of the *objective* and the *subjective*, or those which we recognise by the direct exercise of our senses, and those which we ascertain from the testimony of the patient. Each of these classes ought to be separately investigated, and if, as frequently happens, one eye exhibits differences in the character and progress of the disease from the other, the history of each must be individually considered. We notice the *objective symptoms* in the order in which they would probably engage the attention of a watchful observer. 1. The air and gait of an amaurotic patient is frequently peculiar. If the disease is imperfect, or even if complete, provided it is limited to one eye, the above-mentioned circumstances may not present any thing unusual; but when both eyes are affected, and vision is reduced to a mere perception of light and shadow, there is an uncertainty in the movements of the individual, and a vacancy in the expression of his countenance, which is altogether characteristic of the disease. 2. The eyeballs are frequently affected with oscillatory movements, or they are completely fixed, or from want of harmony in the action of the recti muscles, strabismus varying in form and degree is the consequence. The motions of the palpebræ also may be wholly suspended, or imperfectly or irregularly performed. The globe of the eye must be examined as to its colour, prominence, size, form, and consistence. The sclerotica seldom exhibits a healthy appearance, being either yellowish or of a leaden hue, or loaded with varicous vessels. The eye may be unusually prominent, hard, and tense, or sunk and atrophic, and soft and yielding to the touch; in these circumstances it is sometimes flattened on one or more sides by the pressure of the recti muscles. 3. The pupil may exhibit changes in its form, dimensions, position, and mobility; being irregular, dilated, or contracted, inclining towards some portion of the circumference of the iris, and either sluggish in its movements or completely fixed. In some instances, the pupil retains its natural mobility, although vision is much impaired or even wholly extinct; and in cases where one eye only is amaurotic, the movements of the iris in the sound organ are participated in by that of the diseased: hence the precaution recommended in such circumstances of closing the sound eye, while examining the condition of the other.† 4. The appearance and condition of the humours of the eye are points of much importance.

* The term "complete" ought to be restricted to cases in which the patient has entirely lost the perception of light. It is not so, however, by all writers.—AUTHOR.

† Dr. Mackenzie has suggested, in explanation of this interesting phenomenon, the possibility, in such cases, of the brain or optic nerves being diseased posterior to the communication which takes place between the latter and the third pair, upon the maintenance of which, in its normal state, the motions of the iris depend. The theory appears to be highly plausible.—AUTHOR.

They may exhibit changes in their transparency, indicated by the appearance behind the pupil of the greenish yellow opacity, termed *glaucoma*; or they may be altered in consistence, the globe feeling softer than natural, an effect which may result either from the partial absorption of its fluid contents, or from the breaking down of the membranous septa by means of which the figure and position of the vitreous humour is maintained. Changes in the deep-seated tissues, of a more marked and definite character, may also be exhibited.* 5. The marks of injuries about the head and face, whether old or recent, ought to be observed and inquired into, especially such as from their appearance and position were likely to affect directly or indirectly the superficial branches of the fifth pair of nerves; or any portion of the optic apparatus. 6. As amaurosis is not limited to any period of life, habit of body or pursuit; the age, the general aspect, the physical and moral constitution, and the profession of the patient, ought to be carefully noted and inquired into, as tending to throw much light upon the causes of the disease, and the mode of treatment which it demands.

Subjective symptoms. Of these, the most prominent is the impaired vision, which presents every variety in degree and rate of progress, as well as in the periods and circumstances in which it occurs. It may be sudden and complete, or gradual in its development, slowly advancing to the entire destruction of sight, or remaining stationary after reaching a certain point. It may be constant, or occur at irregular intervals, or at certain fixed periods, assuming the form of hemeralopia or nyctalopia. It may come on without any assignable cause, or succeed to the continued exercise of the eyes upon minute objects. In some cases, the obscurity extends to the whole field of vision, while in others it is limited to a portion or portions; thus, in reading print, the patient either sees the whole page indistinctly or he loses sight of a word or letter here and there. In other instances, one half only of any object is seen ("visus dimidiatus," "hemioopia,") or certain portions of it, or every object appears double ("visus duplicatus," "diplopia.") Some rare examples of double vision with one eye have been observed. Some patients see best whatever is situated obliquely to them, others what is directly in front: some can only distinguish objects which are at rest, others those which are in motion; or all objects are observed as if disfigured and distorted in various ways. In some instances, vision assumes a myopic, in others a presbyopic form. Some persons see best in dark and cloudy weather, others in bright sunshine. In some instances, vision is most perfect in the morning, after the rest of night, when the stomach is empty or the diet restricted; in others, it is much improved by taking food and stimulating drinks.

False impressions constitute an important item in this class of symptoms, and are either persistent or occasional. In appearance, they may be luminous or dark-coloured, and are either general over the field of vision, or limited to particular portions. Those of a bright colour are sometimes only perceptible to the patient when in the dark; in other instances, they are seen both during the day and night, assuming various forms, as of a sea of molten gold, or globes of fire or stars, which are either at rest or in motion, or they resemble flashes and sparks of fire which seem to dart from the eye. In some cases, all objects are seen as if bordered with prismatic colours, or the patient becomes unable to distinguish certain hues which formerly he could easily recognise. The dark-coloured phenomena appear in the form of a general cloud or net-work, or of specks apparently floating in the air, which are either solitary or numerous, and seem to rise and fall with the movements of the eye. Sometimes they resemble membranous films, or chains and coils and numerous other figures equally diversified and fanciful.

* The dilatation of the pupil by means of belladonna, though not always practicable in cases of amaurosis, ought to be attempted, especially when it is accompanied with deep-seated opacity. The degree of susceptibility to its influence still retained by the iris is thereby exhibited; and if the pupil dilates, the nature of the opacity is of course more easily ascertained.—AUTHOR.

The sensibility of the eye to light varies in different cases; generally it is much diminished, but in some instances it is greatly augmented, giving an unnatural clearness and brightness to surrounding objects (oxyopia), or causing so much pain and uneasiness that the patient is unable to bear the ordinary light of day.

A sensation of dryness in the mucous membrane of the eyes and nostrils is a not unfrequent attendant upon amaurosis.

Pain limited to the eyes, or extending to the head and face, is observed in the majority of amaurotic cases. It may be constant, intermittent, or periodic. Its character, degree, and the extent over which it is felt, ought to be inquired into; also, the circumstances which tend to relieve or aggravate it, whether accompanied with vertigo, tinnitus aurium, nausea, a disposition to sleep, or wakefulness. Dulness of one or more of the senses sometimes exists, with failure of memory, and inability to exert certain other of the intellectual faculties. The history of the patient's general health, and especially of any previous attacks of disease, ought to be made a particular subject of inquiry, as tending to unfold the causes which may have remotely and indirectly prepared the way for his present affection. Other points for investigation arising out of the peculiarities of each individual case, will readily suggest themselves to every reflecting mind.

Beer describes, under the name of "*Amaurotic Cat's-eye*," a peculiar and rare affection of the organ, attended with impaired vision, immobility of the iris, and an opalescent reflection from the pupil and bottom of the eye. Mr. Lawrence relates three cases of this disease (*Treatise*, pp. 564-5,) all of which occurred in young persons, and states, that in his experience it has always proceeded to complete loss of sight. The appearance presented by the pupil renders it probable that the disease is dependent upon structural changes in the choroid and retina, with the precise nature of which we are still unacquainted. Dr. Mackenzie adverts to another condition of the eye, also attended with loss of sight, but differing from the former, in presenting an opaline reflection apparently from the anterior capsule of the lens. In one case affecting both eyes, at the patient's request, he introduced a cataract needle through the cornea and pupil, but found no trace of the lens; a profuse discharge of watery fluid followed the puncture, and when the cornea healed, the glittering reflection was observed as before. (*Pract. Treat.* p. 834.)

Causes. The *predisposing* causes of amaurosis do not differ essentially from those which may give rise to disease in any other texture of the eye or organ of the body. It has been observed, in some rare instances, to be congenital, and is hereditary more frequently than cataract, according to Beer, who mentions the case of a family in which it prevailed among the females during three generations. (*Lehre von den Augen Krankheiten*, vol. ii. p. 442.) Whatever tends to depress and exhaust the vital powers may prove a predisposing cause of amaurosis; as chronic discharges of any kind, immoderate venery, or onanism, protracted lactation, the long-continued influence of depressing passions, inanition, and some poisons. Frequent and long-continued attacks of strumous ophthalmia in childhood have been observed to render the individual very liable to amaurosis in after years, from the influence of slight exciting causes. The period of life unquestionably exercises some influence in its production, for although occurring at all ages, it is more frequent in those of mature years, and has been remarked to occur especially about the period of the cessation of the catamenia in females, and the corresponding age in males.

Among the *direct* or *exciting* causes of amaurosis may be enumerated over-exertion of the eyes, or their protracted occupation upon minute objects, or exposure to bright light and intense heat; hence the frequency of the disease among certain classes of artisans, who are necessarily subjected to the influence of such stimuli. A single exposure to one or other of these causes has sufficed in some instances to produce loss of vision; but in general this result is gradually developed, appearing to flow from continued over-excitement of the organ. Injuries from mechanical violence, inflicted upon the retina, optic nerve, or brain; or diseases of these parts, whether consisting in simple congestion or a deficient supply of red

blood, or in more serious structural changes,* either originating in these tissues themselves, or produced by the pressure of morbid growths in neighbouring textures, are frequent causes of amaurosis in some of its most intractable forms. It may also originate from injuries done to the branches of the fifth pair of nerves, or even from mere irritation of these parts, as by a carious tooth,† &c. Violent mental emotions, the effects of lightning, and the rays of a tropical sun, may be mentioned as occasional causes. Amaurosis has also been ascribed to the cessation of inordinate or habitual secretions, and by some writers to the retrocession of eruptive diseases. Derangement of the hepatic system, or continued irritation of the stomach and intestinal canal, the existence of pregnancy, and some diseases of the puerperal state, are among the principal causes of amaurosis in its sympathetic forms. In conclusion of this part of the subject, it may be remarked, that amaurosis is rarely the effect of any single cause; most frequently it is traceable to the combined operation of several, differing perhaps widely from each other, and exerting their influence during a protracted period.

Diagnosis. Impaired vision, whether recent or of long standing, if unaccompanied with opacity in the cornea or behind the pupil, cannot be confounded with any other disease. To distinguish amaurosis from glaucoma is seldom required from the frequency with which they occur together, nor is it practically needful, as the same treatment is in general applicable to both. Amaurosis in its early stages, when combined with glaucoma, may be mistaken for incipient cataract, but the following points of difference will serve to distinguish them:—In glaucomatous amaurosis the opacity is of a greenish yellow hue, deep-seated, and surrounded apparently by a transparent circle, and most obvious on looking directly into the pupil. The opacity in cataract is of a milk and water tint, appearing immediately behind the pupil, by the margin of which it is bounded, and is equally visible in whatever direction the eye is examined. In posterior capsular cataract, the opacity is also deep-seated, and presents the concave surface frequently observed in glaucoma; but it differs from it in exhibiting striæ radiating from a central point, whereas, the opacity in glaucoma is always uniform. In glaucomatous amaurosis the consistence of the eyeball is generally firmer than natural, a circumstance not observed in cataract. The progress of glaucomatous amaurosis is usually slow, both as regards the increase of opacity and the declension of vision; the latter symptom may indeed remain stationary for years. In cataract, vision declines rapidly, and always bears a fixed ratio to the amount of opacity. The pupil in glaucomatous amaurosis is generally sluggish, if not dilated and motionless; whereas, in cataract it retains its natural mobility. Glaucomatous amaurosis is frequently preceded and accompanied by pain and various other uneasy sensations in the eye and head, and by derangement of the functions of other organs, as of the stomach and bowels: the motions of the palpebræ and of the globe may be imperfect or abnormal; there may be ptosis or strabismus, &c. The formation of cataract is not in general attended with any of these circumstances.‡ Other distinctions have been enumerated, derived from the na-

* It was ingeniously conjectured by Mr. Ware, and has since been confirmed by observation, that dilatation of the anterior portion of the "circulus arteriosus," or of the central artery of the optic nerve, might sometimes be the cause of amaurosis. (See *Chir. Obs.*, vol. ii. p. 428, and Mackenzie's *Pract. Treatise*, pp 946, 947.)—AUTHOR.

† An interesting case of this kind is detailed in the *Arch. Gén. de Méd.*, tom. xxiii. p. 261. in which the amaurosis depended upon the irritation caused by a minute splinter of wood which had penetrated through the fang of a decayed tooth.—AUTHOR.

‡ In doubtful cases of this description we have employed the aid of artificial light to assist in determining the diagnosis, as ingeniously suggested by Professor Sanson, senior. It is certainly useful in furnishing negative evidence at least; for where the inverted image of the candle is observed, we may confidently affirm the non-existence of opacity in the posterior capsule of the lens, or in the layers of its substance immediately adjoining. For an account

ture and appearance of the optical phenomena which are visible to the patient, and from the circumstance and direction in which his vision is most perfect; but as they are not pathognomonic of either disease, they cannot be relied upon. Should the amaurosis be combined with cataract, the difficulty of the diagnosis is of course augmented; but a careful observation and comparison of the symptoms of each disease will in general suffice to establish it, and if not, the growing opacity of the lens will in due time render it evident. In cases of amaurotic cat's-eye, the shining metallic appearance behind the pupil might possibly be mistaken for fungus hematodes. For the distinguishing circumstances, we must refer to descriptions of this disease given elsewhere. (See Lawrence's *Treatise* p. 616.)

With regard to the discrimination of the different forms of amaurosis, a careful consideration of the history of each case and of the peculiar combination of symptoms which it presents, will in the majority of instances serve to distinguish the idiopathic from the sympathetic disease. No characteristic signs can be pointed out by which they may be certainly recognised. A similar remark may be applied to the diagnosis of amaurotic affections of an asthenic character, and those dependent upon incurable structural changes, the distinction between which, from its great practical importance, must by all means be made, although often beset with difficulties.

Prognosis. There are two points which, *primâ facie*, ought materially to influence our prognosis, viz. the duration of the disease, and the degree in which vision is impaired. Sudden attacks attended with urgent symptoms of disturbed vascular action, and whether accompanied by paralysis or not, are more favourable than those which come on gradually without any strongly marked indication, one amaurotic and paralytic symptom by degrees succeeding to another. By energetic measures, we may hope to relieve such cases as the former, while in the latter we have to fear the development of morbid growths, or other serious structural changes within the cranium. If the retina is quite insensible, the prognosis is certainly unfavourable, although cases are recorded, in which vision was restored after nearly total blindness of several days' duration. (Lawrence, *op. cit.*, pp. 324, 325.) Should the insensibility continue without improvement during a few weeks, the case may be considered as hopeless. Great alteration in the size, form, and mobility of the pupil, with preternatural hardness or softness of the globe and glaucoma, is unfavourable, as indicating disease of the nervous apparatus of vision, or of the internal textures of the eye, which is probably incurable.

The prognosis is favourable in the sympathetic forms of amaurosis; as we may generally anticipate a return to the healthy condition of the function, where the disease upon which the impaired vision is dependent admits of alleviation or cure. In cases where one eye alone is affected, our prognosis must be extended to the healthy as well as to the diseased organ; for from the intimate sympathy existing between them, it rarely happens that one is attacked without the other participating in the affection at a period more or less remote. Hence active treatment must frequently be adopted and pursued, not as a curative, but as a preventive measure.

Treatment. Amaurosis being accompanied in a large majority of instances with symptoms of inflammation or congestion in the nervous apparatus of vision, antiphlogistic measures are frequently required, varying in kind and degree according to the age and constitution of the patient and the urgency of the indications. Referring to what has been already said in a former article, regarding the treatment of retinitis, which in an acute or chronic form is a fertile source of idiopathic amaurosis, it will suffice at present to observe that when the patient is young and plethoric and the inflammatory symptoms active, depletion, both local

of this interesting phenomenon, and its application to diagnosis of opacities behind the pupil, see "Remarks on Lenticular Glaucoma," by Dr. Mackenzie in *London Med. Gaz.*, April 14, 1838.—AUTHOR.

and general, must be practised, with the free exhibition of purgatives, and the employment of counter-irritation. Should these measures fail in producing the desired effect, recourse must be had to mercury, which from its influence in controlling inflammation in other textures, analogy would suggest, and practice confirms, as being equally useful in the present instance. Calomel and opium ought, therefore, to be given till the mouth is affected; and, generally speaking, the influence of this remedy upon the system ought to be maintained during several weeks, to ensure all the benefit which it is capable of affording. If the antiphlogistic treatment and mercury equally fail, little more remains to be done: measures ought to be taken to promote the general health, the maintenance of which may possibly operate beneficially upon the diminished powers of vision. The effect of counter-irritation, by means of a succession of blisters, may also be tried.

In cases of a more chronic character, occurring, as we every day witness, in combination with a debilitated constitution and disordered general health, such activity of treatment would be highly prejudicial. Topical bleeding, however, may still be requisite, the indication of which, as well as for general depletion in other instances, is to be derived, not from the condition of the system, but of the part. In such instances as the above, although mercury is to be employed chiefly as an alterative, considerable benefit is frequently derived from the continuance and gradual increase of the dose, till the mouth is slightly affected. The employment of counter-irritation must not be omitted; repose of the organ should be enjoined, and the use of tonics, both dietetical and medicinal, is often a useful auxiliary. In cases attended with symptoms of cerebral congestion of long standing, along with topical bleeding and the exhibition of purgatives, we have derived considerable benefit from the insertion of a seton in the neck. The amaurotic affections which we have termed sympathetic or symptomatic, being in general dependent upon a disordered condition of the stomach and bowels, arising from the presence of irritating matters or some other cause, whether temporary or permanent, the state of these organs must be especially attended to. The emetic and "resolvent"* plan, as proposed and practised by Richter, Schmucker, and Scarpa (*Pract. Obs. on Dis. of the Eye*, p. 486,) might be supposed to be peculiarly applicable in such circumstances; but Messrs. Lawrence and Travers, both of whom have given it a fair trial, concur in stating that they have never derived any benefit from its employment. The latter remarks (*Synopsis of the Dis. of the Eye*, p. 310,) that "the cases of gastric disorder to which it is especially applicable, are most benefited by a long-continued course of the blue pill, with gentle saline purgatives and bitter tonics." It must be admitted, however, that many of the temporary amaurotic affections, especially of children, are speedily relieved, if not entirely removed, by an emetic, succeeded or not, as the case may require, by a few brisk purgatives.

Where amaurosis can be traced to general debility of the system, induced as is sometimes the case, by protracted lactation, or the abuse of other natural secretions, the indications of cure are so obvious, as to require no additional comment.

Various powerful stimuli have at different times been employed in the treatment of amaurosis, on the supposition that the disease might be dependent upon a diminished energy or want of tone in some portion of the nervous apparatus of vision. Of one and all of these remedies it may be affirmed, that their indiscriminate use has been productive of much evil, and that in the early stages of the disease accompanied with symptoms of local inflammation, they are wholly inadmissible. Where no such objection exists, and the concurrent symptoms appear to indicate a condition of diminished nervous energy, we see no objection to a judicious trial of their powers, although the ill-success which, generally

* The "resolvent pills," which formed an important item in the scheme, consist of a farrago of drugs, and fifteen of them are directed to be taken three times a-day for some weeks.

speaking, has hitherto attended the experiment, does not warrant us in building much upon their efficacy. Mr. Hey of Leeds (*Med. obs. and Enq.*, vol. v.) and the late Mr. Ware (*op. cit.*, vol. ii. p. 409,) have related cases which sufficiently attest the occasional benefit of electricity; while Messrs. Travers (*op. cit.*, p. 309,) and Lawrence (*op. cit.*, p. 543,) concur in stating that they have never witnessed any good effect from its employment, or that of galvanism, although repeatedly tried in cases of a favourable description. Mr. Tyrrell's (*Cyc. of Pract. Surg.*, p. 105) testimony is nearly to the same effect.

Strychnine has been much employed in the treatment of amaurosis since its first proposal by Dr. Shortt. (*Edin. Med. and Surg. Journ.*, vol. xxxiv.) The cases which he has published show very clearly the immediate benefit which may result from its exhibition, while the doubts which he expresses as to the permanency of these effects, has been only too amply confirmed by the subsequent experience of others. Dr. Shortt recommends the strychnine in instances where the symptoms are apparently dependent upon simple want of power or atony of the nervous structure, or when a congested condition of the capillaries of the retina, unattended with vascular excitement, may be supposed to exist. In such circumstances, we should not hesitate to employ it after the failure of other and more certain remedies. The most efficacious mode of applying the remedy is to dust it upon a blistered surface, from which the cuticle has been removed, over the eyebrow or upon the temple; commencing with one sixth of a grain and increasing the quantity daily, till the constitution is sensibly affected, as indicated by headach, pricking pains over the body, or tremors, when it should be discontinued, and on resuming its use, the dose should always be considerably diminished. Mr. Tyrrel (*op. cit.*) observes, that he has made trial of strychnine in cases apparently the most appropriate for its use, and has prescribed the remedy in various ways, both internally and externally, continuing it till the involuntary muscular contractions were frightful; but without meeting with a *single* instance of benefit from its employment. Dr. Mackenzie (*op. cit.* p. 916) states, that he has never witnessed any remarkable effect which could be fairly attributed to the strychnine. We have ourselves frequently made use of it, and still more frequently witnessed its employment in the practice of Mr. Morgan in Guy's hospital; and we are unable to recall even *one* instance in which it proved *permanently* beneficial, although *temporary* improvement of vision to a remarkable degree was sometimes produced. The testimony of the above mentioned authors, as being the most competent judges of the merits of this remedy, ought to deter the less experienced from its indiscriminate employment, and caution them against buoying up the unfortunate subjects of incurable amaurotic disease with hopes of returning vision, which are only destined to be cruelly disappointed.

Stimulating applications to the eyes and nostrils, in the form of vapours and snuffs, have been recommended; and from the sympathy which exists between the branches of the trigeminal nerve and the retina, they may possibly be of service in cases where a stimulus is required. On the same principle, a succession of small blisters to the neighbourhood of the orbit has been productive of benefit in some instances. Amaurosis succeeding to wounds of the frontal or other branches of the fifth pair of nerves, has been in some instances cured by a complete division of the injured twig; generally however the operation has failed to relieve. Belladonna, given internally or rubbed upon the surface, is sometimes productive of benefit in such cases, and they occasionally undergo a spontaneous improvement. We purposely abstain from mentioning many other remedies which have been proposed in the treatment of amaurosis, inasmuch as experience has demonstrated their total inefficacy.

INFLAMMATION OF THE EAR; OR, OTITIS.

Definition of otitis and otorrhœa.—Acute and chronic otitis.—Symptoms of acute external otitis—of acute internal otitis—of chronic otitis or otorrhœa.—Causes.—Anatomical characters.—Diagnosis.—Prognosis.—Treatment of acute external otitis—of acute internal otitis—of chronic otitis.

THE term Otitis (from *οὖς*, *πτος*, the ear) is applied to inflammation of one or more of the parts which constitute the organs of hearing. From the pain which frequently accompanies the disease, some writers denominate it *otalgia*, (from *οὖς*, *πτος*, and *αλγος*, pain,) while, by most authors, the chronic form has been called *otorrhœa*, (from *οὖς*, *πτος*, and *ρεω*, to flow,) on account of the discharge by which it is characterized.

This disease was very imperfectly described, before M. Itard gave an excellent account of it in his work (*Sur les Maladies des Oreilles*, &c.,) published in 1821. The researches of Saunders, Abercrombie, and Pilcher, in England; of Lallemand, Andral, and Deleau, in France; and of P. Frank, Lincke, and Kramer, in Germany, have tended still farther to clear up the obscurity in which it was formerly involved. These writers have shown that a knowledge of auric medicine can only be acquired by those who are acquainted with the general laws which regulate disease throughout the animal economy.

Otitis has been divided into the acute and chronic, the distinction being founded on its severity and duration. Acute otitis has been subdivided into the external and internal; the former including inflammation, more or less general, of the meatus auditorius externus and membrana tympani; the latter, inflammation of the tympanum and Eustachian tube.

Symptoms of Acute External Otitis. This form generally commences with an unpleasant sensation or slight pain in the auditory canal, resembling that occasioned by the presence of a foreign body in the ear; in other cases, it is of a burning or itching nature. This gradually increases, until there is acute, occasionally lancinating, pain, sometimes of a dull, heavy, dragging, and tearing character, increased on pressure; by the motions of the lower jaw, or by the contact of cold air and hot fluids. The hearing is confused or impaired, and accompanied by whistling, buzzing, ringing, or roaring sounds, intermittent or constant. The membrane lining the meatus is red, and generally more or less swollen. At a period varying from a few hours to three or four days from the commencement of these symptoms, a thin, limpid, or sanguinolent discharge, gradually becoming more consistent, and of a whitish, yellowish, or puriform appearance, takes place from the meatus. In some cases, Dr. Kramer has described the tumefaction of this stage to be so great as scarcely to permit a knitting needle to be introduced, and in other cases as affecting only one side of the meatus, forming a kind of elevation which extends irregularly along the cavity, and also affects the membrana tympani. This lining membrane is usually covered with pimples, filled either with a serous or purulent fluid; some of which having burst, leave ulcerations that continue to furnish the discharge, or crusts which more or less block up the cavity of the meatus. The discharge is occasionally inodorous, but more frequently fetid, and sometimes so acrid as to produce considerable irrita-

tion in the parts over which it flows. Granulations often form, resembling excrescences of polypi, of a soft, spongy, and very red appearance, and covered with a copious muco-purulent secretion: these granulations bleed from the slightest touch, but sometimes they have a broad base, are hard, insensible, of a pale red colour, and bleed little or not at all. In cases in which the membrana tympani appears to be primarily affected, it is more or less red, rough, swollen, and opaque, and sometimes covered with small projecting glands or follicles. Occasionally, also, bundles of vessels may be seen in it, and the point of the handle of the malleus cannot be distinguished. As the discharge becomes abundant, the pain usually decreases, unless the inflammation extend to the internal ear. The consistence of the matter discharged may undergo changes several times in the course of a week or even in a day. Sometimes it stops suddenly from the accumulation of crusts having caused a mechanical and temporary obstruction. As the inflammation declines, however, it often becomes thicker, and presents the colour, consistence, and even odour, of caseous matter. (*Itard.*) The discharge now gradually diminishes, and gives place to a more than usually abundant secretion of wax, sometimes accompanied by a serous exudation from behind the ear. Itard remarks, that now and then perforation of the cartilaginous portion of the external ear takes place, whereby a fistulous communication is established, connecting the cavity of the meatus with the cellular substance which unites the cartilage and the bone. In two or three days, broad, dry, cuticular scales are thrown off, and a tenacious cerumen, of a bright or dark brown colour, is secreted, which is mixed up with cuticular scales, adhering firmly to the walls of the meatus, which is thus completely stopped up.

Acute internal otitis usually commences with acute deep-seated pain in the interior of either ear, rarely in both, accompanied by more or less general headach or hemicrania, rapidly increasing in severity, with whistling, clanging, loud, or beating metallic noises, and a sense of bursting or distention. Mastication and sudden noises or motions of the head augment the symptoms. The pain in the head may be violent, lancinating, or compressive, fixed or undefined. Some patients complain of insupportable heaviness in the head, and others think that the cranium will burst open. The pulse is hard and frequent, the skin hot, the countenance anxious, the eyes injected and sensible to light, the tongue furred, the taste vitiated, the appetite lost, with febrile excitement. At night, there is loss of sleep, great restlessness, sometimes delirium, and in children convulsions. Occasionally there is an unpleasant itching at the bottom of the throat, towards the orifice of the Eustachian tube, with swelling of the tonsils. An examination of the external ear exhibits nothing abnormal. These symptoms, if actively combated at the commencement, may, in two or three days, partially subside; the pain diminishes in intensity; the loud noises in the ear give way to violent hissing, the taste and appetite return; and the febrile symptoms gradually disappear. The hissing or buzzing noises with indistinct hearing usually continue three or four weeks.

But should the inflammation not thus terminate in resolution, perfect deafness is occasioned in the affected ear; the fever continues, and sometimes assumes a nervous or typhoid type, attended with much exhaustion; while the local inflammation gives rise to products which accumulate in the cavity of the tympanum, and at length force a passage towards the external surface. These products may be discharged, 1. by the meatus externus, from perforation of the membrana tympani; 2. into the throat, through the Eustachian tube; and 3. through a fistulous opening in the mastoid process. The first is by far the most common, its frequency to that of the second, according to Itard, being ten to one.

The discharge of matter establishes, according to some authors, the *second stage* of the disease. When this takes place by perforation of the membrana tympani, it occurs suddenly, generally about a week after the commencement of the symptoms; a large quantity of matter being discharged, sometimes mixed with bloody streaks, as if an abscess had burst. The acute symptoms then generally diminish, and the patient experiences considerable relief, so long as the flow of matter is

abundant and unimpeded. Sometimes, however, it is obstructed, either by its concreting and filling up the perforation in the membrana tympani—by causing inflammation and tumefaction in the external meatus—or by accumulating and getting incrustrated in that part of the ear. In either case, the acute symptoms are likely to return, unless the obstruction is removed. A communication is now established between the posterior fauces and the external auditory passage, if, as is rarely the case, the Eustachian tube be not obstructed. This may be proved by causing the patient to expire forcibly while the mouth and nose are shut. By this act, bubbles of air, mixed with fluid, escape from the meatus; or if the flame of a candle be placed before the external passage, it receives an evident impulse.

When the matter is discharged through the Eustachian tube into the fauces, it may take place suddenly or gradually. In the former case, a sensation is felt as if an abscess in one of the tonsils had burst; there is sudden expectoration of a muco-puriform, or purulent matter, sometimes of a disagreeable taste, and recurring in smaller quantities at uncertain intervals. In the latter case, the accumulated matter is discharged into the throat in small quantities, and brought up in the form of thick, tenacious, and sometimes bloody sputa, which is detached from the fauces with much difficulty, especially in the morning. Under such circumstances, the lining membrane of the Eustachian tube, by participating in the inflammation, may be partially obstructed. Not unfrequently, also, the discharge of matter by tickling and irritating the glottis, produces a very unpleasant cough, a symptom which may induce the superficial practitioner to overlook its real cause.

When the discharge takes place through a perforation in the mastoid process, it is an evidence of the inflammation having extended to the membrane lining the cells in that portion of the bone, and the formation of an abscess behind the ear. This is a rare termination of the acute otitis, and has been observed most frequently in those cases which supervene on the decline of acute affections. (*Itard.*) It usually degenerates into the chronic form of the disease, and will be described more particularly under that head.

The symptoms which follow the discharge of matter differ according to the morbid alterations which have occurred in the internal ear. Thus the hearing is either entirely lost, remains impaired, or is recovered, in proportion to the nature and extent of the morbid lesions to be afterwards noticed. The symptoms usually lose their severity before a month has elapsed, at the termination of which period, if they have not disappeared, the disease may usually be considered chronic, and otorrhœa is established. Sometimes, however, the symptoms increase in intensity—there are rigours, spasmodic phenomena, more or less marked, with greater or less rigidity of the muscular system; the restlessness and agitation at night continue, which, with delirium, at length appear during the day. There is sometimes more or less paralysis and coma, followed by death. Sometimes otorrhœa does not occur; the pain becomes apparently deep-seated; the patient is melancholy and dull, notices nothing, moves his head backwards and forwards, holding it between his hands, and at last falls into a comatose state, and dies.

Deleau and Kramer describe a form of internal otitis, which the latter considers to be occasioned by inflammation of the mucous membrane, as contra-distinguished from that of the cellular tissue and periosteum. The lining membrane of the cavity of the tympanum being fibro-mucous, at once a mucous membrane and periosteum, it may be doubted how far this distinction is borne out by anatomy. Several facts, however, indicate that this membrane may be the seat of a peculiar inflammation, resembling the blenorrhœal of some other mucous membranes, in which the violent symptoms above described are absent, and the principal lesion consists in impaired hearing from accumulation in the cavity of the tympanum, and the patient complains of a sensation of fulness and heaviness in the ear without pain; the hearing is always more or less dull, and nothing can be discovered in the external auditory canal. The only signs of this lesion are drawn from various kinds of auscultatory phenomena produced by injecting air into the internal ear. These will be more fully noticed under the head of *Diagnosis*. These symptoms are generally

sub-acute, but become chronic, and Mr. Pilcher is of opinion that they not unfrequently lead to acute internal otitis. (*On the Ear*, p. 206.)

Inflammation of the internal ear may arise secondarily from the extension of disease in the Eustachian tube, from its lining membrane participating in the inflammation of the throat in angina, or from the extension of ulceration and other affections in the region of the throat. In this case, the patient may complain of momentary deafness, without its having been preceded by acute symptoms in the ear. This temporary deafness may be of longer or shorter duration, with intervals of perfect hearing. The patient sometimes hears his own voice worse than that of others, and occasionally has a crackling, gurgling, or detonating sensation in the throat leading to the ear. The blenorrhœal form of internal otitis, also, is very liable to be complicated with stricture of the Eustachian tube, occasioned by an acute or sub-acute inflammation of its lining membrane. In all such cases, a correct idea of the state of the parts is only to be obtained by means of injections and catheterism through the guttural orifice of the tube, as recommended by Deleau, Kramer, and Pilcher.

Chronic otitis, usually termed *otorrhœa*, is often a termination of acute otitis, although it may also be a primary disease; and the discharge from the ear be established without pain, or other prominent symptom. This form of the disease is more frequently met with than the acute, and the long continued escape of matter in many cases, without injuriously affecting the organs essential to life, is probably the principal reason why it has been regarded with so little attention.

Chronic, like acute otitis, may be confined to the external or internal ear. It rarely happens, however, if its progress be not checked, from whatever part the disease originally proceeds, that it does not sooner or later extend from the one to the other by perforation of the membrana tympani. Itard, and the generality of authors, have divided otorrhœa into the *mucous* and *purulent*, but that distinctions should not be drawn merely from the character of the discharge is farther shown by recent microscopic observations, and more particularly from the researches of Haenle (*Über Eiter und Schleim*. Berlin, 1838,) who has demonstrated that it is utterly impossible to distinguish the fluids secreted from inflamed tissues into mucous and purulent. The point of real importance to determine is, whether the inflammation be confined to the membranes lining the auditory passages, or whether it be confined with caries of the bone, or complicated with lesions of the brain. With a view of directing attention more especially to these points, we shall consider chronic otitis as occurring, 1, with inflammation only of the membranes lining the various passages of the ear; 2, with caries of the bone; and, 3, with cerebral disease.

1. *Chronic otitis limited to the membranes* may be confined to the external ear, and be the result of acute otitis, or be induced by vegetations, thickening of the lining membrane, herpetic eruptions, or other chronic lesions of the lining membrane of the meatus externus. It is most common in children of a scrofulous constitution; apparently depends upon the general morbid affection inherent in the system, and disappears when this is removed by change of diet or residence, on the attainment of puberty, or by other circumstances which produce a radical change in the economy. The hearing is more or less impaired, according to the greater or less degree of obstruction in the meatus, either by the accumulation of matter, growth of vegetations, or thickening of the lining membrane of the meatus or membrana tympani. The matter itself varies in colour, odour, and consistence, in the course of the disease. The quantity discharged also varies at different times, although in general it bears a relation to the extent of the inflammation.

In the majority of cases, a perforation is made sooner or later in the membrana tympani, and thus the disease involves the internal ear. Under such circumstances, the hearing becomes more and more dull, according to the extent of the injury inflicted on the membrana tympani and chain of bones connected with it. No other marked symptoms, however, occur so long as there is no impediment

to the flow of matter. Sometimes this is suddenly arrested, and then acute symptoms generally supervene; such as severe pain in the ear, fever, more or less violent headach, and other cerebral symptoms, which either disappear on the re-establishment of the discharge, or by their continuance prove destructive to life. Sometimes the suppression of the otorrhœa is followed by other disorders; such as affections of the eyes, porriginous eruptions on the scalp, swelling of the lymphatic glands of the neck, &c. Itard has once seen tumefaction of the testicle in a young man from this cause; Lallemand also has observed the otorrhœa alternate with accessions of rheumatism, catarrh of the bladder, leucorrhœa, &c.

The affection called by Roche *otite chronique sèche*, and by Pilcher *erythematic otitis*, and which has also been described by Mr. Earle (*Med. Chir. Trans.* vol. x.,) is not, in our opinion, an inflammatory disease, but depends upon a perverted secretion of the lining membrane, which occasions a morbid deposit, similar to that formed in the *muguet* of French writers.

The duration of chronic otitis limited to the membranes varies infinitely; it may continue for many years without producing any serious result. In some very rare cases, the otorrhœa gradually diminishes, and at length wholly disappears without producing any unpleasant result, but more frequently even this spontaneous cessation of the disease occasions a greater or less degree of deafness. This may arise from extensive lesions of the membrana tympani; thickening or structure of the external meatus; loss of the tympanal bones, or complete obliteration of the external passage, from adhesion of its walls; in which case total loss of hearing is the invariable result. Even these terminations may be considered comparatively favourable, as in the majority of cases the discharge having accumulated more or less in the cavity of the tympanum, at length becomes acrid, induces ulceration and denudation of the membranes, and ultimately caries of the surrounding bone.

2. *Chronic otitis complicated with caries of bone* may be either the result of acute or chronic inflammation limited to the membranes, or it may, although more rarely, be the primary disease. In the external ear, it usually arises from inflammation of the periosteum, as pointed out by Kramer. A tumour forms towards the base of the external meatus, without pain or other inconvenience, except deafness to a greater or less extent. When the abscess opens, an ichorous fetid fluid is discharged, the deafness is diminished, as long as the passage is clear. The discharge may thus continue for years, but if exfoliation take place, the ulcerated part begins to heal, this process being accompanied by a great tendency to narrowing or obliteration of the meatus.

When the bones of the internal ear are diseased, the matter evacuated, instead of retaining the usual yellow colour and consistence of healthy pus, becomes thin, of a grayish or dirty colour and more or less sanguinolent; it exhales a peculiar, sometimes very fetid odour, similar to that generated by carious bones, and frequently stains a silver probe of a brown or violet hue. Sometimes the acrimony of the discharge irritates the lobule of the ear and other parts with which it comes in contact, and occasions more or less swelling of those parts. As the disease advances, the discharge becomes mixed with small fragments of bone. In these cases, the patient feels a dull pain in the ear, which extends to a greater or less extent over the side of the head, with more or less impaired hearing. The mastoid process is the part most frequently affected; a dull pain, increased on pressure, being felt. In some cases, the skin which covers it becomes reddish, slightly swollen, and the seat of a purulent deposition or abscess which is not accompanied by any acute pain. The skin subsequently becomes of a reddish brown or violet colour, more and more thin, and at length ulcerates, giving exit to the sanious discharge above described. A fistulous communication now exists between the external surface behind the ear and the cavity of the tympanum, through the mastoid process, the cellular structure of which is perforated, destroyed to a greater or less extent, and infiltrated with matter. On introducing a probe, the naked rough bone may be readily detected, and in several cases the

instrument penetrates with facility into the mastoid cells, and even into the cavity of the tympanum. If the membrana tympani be ruptured, a fluid injected through the external opening, escapes by the external meatus, and occasionally by the Eustachian tube. Sometimes the discharge from the fistula alternates with that from the auditory canal, or should it be suppressed, the phenomena formerly alluded to may be induced. Occasionally, the pus penetrates between the muscles attached to the mastoid process, and the abscess opens low down in the neck. Under such circumstances, it is very liable to be mistaken for an ordinary scrofulous tumour, and the ear affection to be overlooked. When on the other hand, the caries of the mastoid process takes place with still greater slowness, its cellular structure becomes degenerated and broken down, and escapes through the meatus externus with the sanious discharge, while its rounded form gradually disappears, without the soft parts covering it being affected: hence Lallemand considers it important, in all cases of chronic otitis, to compare the volume of the two mastoid processes.

Sometimes the matter collects in the mastoid cells, and after gradually excavating the bone at length finds its way through the Eustachian tube. In such cases, in addition to the dull pain, increased on pressing the mastoid process, there is a continual noise in the ear, resembling that made by a windmill, a waterfall or unpleasant whistling, which deprives the patient of sleep. The hearing at length becomes more and more obscure, or is entirely lost, although in some cases it has returned, and again disappeared at intervals; the noises also may increase or diminish in intensity; these symptoms, together with the loss of hearing, apparently depending upon the mixture of air and pus in the Eustachian tube, and the plenitude or vacuity of this cavity. The patient has sometimes a bitter taste in the mouth, with nausea and vomiting. Occasionally, he is suddenly seized with cough, and expectorates a sanious purulent matter, mixed with bloody streaks; a symptom which is very liable to appear in the morning. Whatever food is taken has a nauseous, disgusting taste; the appetite is lost; the patient becomes melancholic, emaciates and loses strength every day. These symptoms are referrible to the caries of the bone and the sanio-puriform discharge dropping into the fauces, although they have often been mistaken and attributed to some affection of the stomach or lungs. The caries however extends; involves the other osseous parts of the organs of hearing; perforates the dura mater, and affects the brain, even in some cases before its real nature is suspected.

The petrous portion of the temporal bone which encloses the semicircular canals, is the portion next most likely to be affected; and when this occurs, the destructive process is very liable to be communicated to the brain, giving rise to the symptoms to be presently described. Sometimes the caries follows the aqueduct of Fallopius, probably by the opening which gives passage to the chorda tympani, and then the patient experiences acute pains in the ear, spasmodic contractions of the muscles of the face on the side affected, terminating in paralysis. Lallemand has met with five cases of this kind, in which the phenomena were to be attributed to the facial nerve having participated in the structural disorganization, and others are recorded by Bérard. The caries may also follow the aqueduct of the cochlea, and more rarely the internal auditory canal. It seldom happens, however, that, when caries is once established, its progress is limited to one direction. The same causes which occasion it in one situation may induce it in others, and hence the whole of the mastoid process and petrous portion may be destroyed. Lallemand cites a case from Beaugrand, in which the mastoid, coronoid and styloid processes were destroyed by caries, as well as the glenoid cavity of the first vertebræ, the odontoid process of the second, and the inferior part of the occipital bone. He says he has seen a similar case, in which the head was inclined on the shoulder of the affected side, with incomplete paralysis of the superior extremities, painful swelling of the neck, &c., (*Lettre iv. p. 222.*) The duration of chronic otitis with caries may vary from a few months to several years, during which period the symptoms may differ according to the passage by which the matter is discharged. This may take place in the same patient some-

times by the external meatus, sometimes by a fistulous opening, at others by the Eustachian tube giving rise to the different effects we have noticed.

3. *Chronic otitis complicated with cerebral disease* is analogous to the cerebral otorrhœa of M. Itard, which he divided into the primitive and consecutive; the former, according to him, commencing in the brain and extending to the ear, while the latter commences in the ear and extends to the brain. The valuable researches of Lallemand, however, have made it very problematical whether the cases described by Itard and others as primary otorrhœa. are not in point of fact consecutive to chronic disease in the bone, in which the cerebral affection is the first circumstance which attracts the attention of the patient and practitioner. In all these cases, caries of the petrous portion of the temporal bone is found, and it is evidently more likely that this should be the cause of the cerebral inflammation or abscess in its neighbourhood than that inflammation should have existed a long time without prominent symptoms, pus have slowly formed and produced perforation in the hardest and thickest of the cranial bones. It is worthy of remark, also, as rendering the latter opinion still more improbable, that while cerebral abscesses do not produce perforation in the softer bones which form the walls of the cranium, so they seldom communicate with the interior of the ear by means of the meatus auditorius internus. Whichever theory be adopted, it is important to know that the cerebral symptoms may occur previously to any discharge from, or other prominent symptom in, the ear, and, on the other hand, may supervene on chronic otitis of longer or shorter standing. In this sense, therefore, the terms primary and consecutive may be used. In either case, the symptoms are, obstinate headach, at first obtuse, afterwards lancinating and severe; sense of weight in the head; redness of the eyes; pain at the base of the orbit; sometimes convulsive contractions in the muscles of the face; tension or slight swelling of the scalp; sensation of constriction in the cranium, as if it were not large enough to contain the brain; sometimes lesions of the intellectual faculties, especially of the memory; hard and frequent pulse; loss of appetite; wakefulness, rigours, general fever, increased at night; furred tongue, fetid breath, increased wasting, general collapse, anxiety of the countenance, delirium, continual moaning, contracted or dilated pupils, strabismus, convulsions, rigidity of the muscular system or palsy, coma and death. These symptoms, which vary according to the seat and intensity of the cerebral disease, are of the same nature, and follow the same progress, as inflammation of the brain and its membranes. When the discharge from the ear has preceded the cerebral symptoms enumerated above, it is generally diminished before they appear; when, on the other hand, they appear consecutively, the membrana tympani is sometimes ruptured, and a considerable quantity of matter escapes from the external meatus. Under such circumstances, the cerebral symptoms are for a time alleviated, and Itard has seen two cases which terminated in recovery after this occurrence. In the majority of instances, however, they return, and continue until the death of the patient. Sometimes, when cerebral disease supervenes on long-continued chronic otitis, the fatal event is more gradual; hectic fever supervenes, which by degrees destroys the constitution, and the individual sinks exhausted. It may also happen in otorrhœa accompanied by occasional headach, that muscular contractions or coma may come on suddenly, and either prove quickly fatal, or hemiplegia may be the result: in which case, an apoplectic attack generally sooner or later closes the scene.

Causes. Otitis has been observed rather more frequently before than after puberty, but both sexes appear equally liable to it. (*Lallemand.*) The causes which more especially predispose to the affection are a plethoric state of the body, or the scrofulous and gouty diathesis (*Kramer;*) the period of dentition, the syphilitic poison, previous attacks, and diseases of the throat, pharynx, and œsophagus.

The disease may be excited by a rapid current of air acting on the head, or by exposing it uncovered to a cold atmosphere, especially during perspiration, or immediately after removal of the hair, imprudent bathing, the introduction of foreign bodies into the ear, injury of the external meatus by pricking or cutting instruments, caustic applications, stings of insects, irritating salves or drops, &c., the

employment of galvanism or of electricity directed towards the ear for the cure of deafness (*Roche*;) irritating injections into the auditory canal, the sudden disappearance of ophthalmia, the suppression of chronic discharges, the extension of scrofulous, syphilitic, herpetic, or porriginous diseases of the skin to the ear. It is likewise frequently one of the sequels of exanthematous fevers, more especially variola, erysipelas, and scarlatina, or of diseases of the throat and pharynx, &c. It has also been apparently occasioned by the irritation of carious teeth, cleft palate, congestive disorders of the brain, and injuries of the head. It must, however, be stated, that otitis has come on without any obvious exciting cause.

Anatomical characters. At an early period of the disease, the lining membrane of the auditory passages is injected and reddened, and the vascular congestion most frequently causes it in a greater or less degree of tumefaction, producing more or less obliteration of the canal. Pimples are often seen covering the membrane; these are sometimes few in number but of large size; in other cases they are very small, resembling millet grains sprinkled over the walls of the meatus. The lining of the external meatus in some cases strongly resembles inflamed mucous membrane, the secretion covering it being similar in appearance to that furnished by inflamed mucous membrane in other parts of the body; hence the secretion presents different appearances, according to the intensity and character of the inflammation. These appearances, as stated by *Kramer*, vary according to the tissues principally affected, if the glandular structure of the investing integument of the external meatus be inflamed, the discharge is of a catarrhal nature; if it be the cellular tissue of this passage, the fluid is of a phlegmonous purulent character. Not unfrequently the inflammation in the lining membrane gives rise to unequal swelling of its structure, giving the appearance of excrescences of polypi; these are either soft, spongy, or of a bright red colour, vesicular, bleeding on every touch, sensitive, covered with a copious mucous secretion, pedunculated or globular; in other cases, they have a broad basis, almost as hard as cartilage, or even as bone; insensible, bleeding little or not at all, and rather of a pale red colour. (*Kramer*.) Occasionally, but more rarely, true abscesses form in the external meatus, sometimes giving issue to pure pus, or to a degenerated sanious discharge. In the latter case, inflammation of the periosteum has taken place, followed by caries in the neighbouring bone, as pointed out by *Kramer*; sometimes a membranous or albuminous exudation forms on the surface of the canal, similar to that observed in the mouth, and which has been described by the French under the name of *muguet*. Occasionally the thickening of the membrane is so great as entirely to obstruct the canal; the obstruction has also been occasioned by a species of septum originating in elongation or diseased growth of the cutis, as in a case of *Maunoir's* quoted by *Saunders*; on the laceration of which, hearing returned. Obstruction of the canal is also very likely to follow the contraction of the ulcer after exfoliation of bone. The membrana tympani has been found wholly destroyed or more or less perforated and injured; it is not unfrequently opaque and thickened; sometimes as hard as cartilage. *Saunders* had a preparation in which half this membrane had been destroyed as far as the manubrium of the malleus, around which the cutis of the meatus had grown and joined the lining of the tympanum. (*On the Ear*, p. 69.) The lining membrane of the Eustachian tube undergoes similar alterations, producing stricture or obliteration; its calibre may also be lessened or obstructed, from being involved, or pressed upon, by different swellings or tumours in its neighbourhood.

The cartilages may also be affected, even in the acute form of the disease. *Andral* has found the cartilage of the external meatus softened and perforated in individuals who have laboured under otitis only fifteen days. Sometimes the perforation of the cartilage is produced from without inwards, by an abscess formed between the mastoid process, the angle of the jaw, and hollow of the ear. It has also followed suppuration in one of the parotids, the pus, first formed in the granu-

lar structure of the gland, finding its way into the external meatus by a fistula of its cartilaginous walls.

Lesion of the osseous structure is one of the most serious results of the disease. The tympanal bones are generally those which are first affected, and they either escape through the perforated membrana tympani, the articulations and membranes which connect them together being destroyed, or, as rarely occurs, they become anchylosed. In the former case, of the four tympanal bones, the two outermost, the malleus and the incus, or these with the orbicularis only, may be detached and expelled, while the stapes is left behind; or it may happen that the supuration has affected the base of the stapes and the membrane connecting it to the fenestra ovalis. The vestibule is thus exposed, and the water it contains escapes. (*Edin. Med. and Surg. Journ.*, vol. xix, pp. 92, 93.) The other osseous textures connected with the organs of hearing are the different portions of the temporal bone. The hollow parts of the bone are lined by a thin membrane, which is continuous, and thus inflammation in one part of it is liable to extend to the others: hence caries of the osseous structure follows certain directions, which bear a relation to the different canals that perforate it. The communication of the mastoid cells with the cavity of the tympanum is much more direct than with the labyrinth; and its soft structure, and the extent of the membrane which traverses it, render this portion of the bone especially liable to disease. It is occasioned by the destruction of the thin periosteum, the denudation of the bone, followed a suppuration of its cellular tissue, while the matter is discharged in the various ways previously described. After having destroyed the mastoid cells, the caries often extends to the petrous portion of the bone, most frequently that part which contains the semicircular canals. The superior semicircular canal is separated from the cavity of the cranium by a very thin but compact plate of bone; hence the reason of the communication of the caries with the membranes of the brain being almost always at the superior and anterior surface of the bone, as remarked by Itard and Lallemand.

The morbid alterations found in the brain and its membranes are analogous to those described under INFLAMMATION OF THE BRAIN. The dura mater only may be diseased; in which case a portion, for the most part corresponding to a carious spot in the bone below it, is inflamed and thickened, or spongy, disorganized, or ulcerated, and in most cases detached from the bone. Occasionally, on lifting it from the petrous portion of the temporal, black spots are found on its external surface, which cover similar discolourations in the bone. This degeneration, and the other morbid changes, just noticed, may be confined to the dura mater, or may have extended to the arachnoid, and involved, to a greater or less extent, the latter membrane. Pus is frequently found extravasated between the dura mater and bone, or between the former and the arachnoid membrane; sometimes there is effusion of false membrane in the latter situation: both these products have been occasionally found to extend more or less over the surface of the brain or cerebellum, or along the tentorium. Sometimes the alterations in the membranes are connected with softening or with an abscess in the brain, the latter not unfrequently encysted, and communicating with the cavities in the internal ear. Such alterations may or may not be more or less connected with injection of the cerebral substance, effusion of fluid into the ventricles or arachnoid cavity, and other signs of acute inflammation. Morgagni, Itard, Abercrombie, Lallemand, Brodie, O'Brien, Pilcher, and others, relate several cases where the cerebrum or cerebellum has been the seat of large abscesses, in some of which the matter was of a green colour and fetid odour.

Diagnosis. An accurate diagnosis of the various forms of otitis can only be arrived at by a careful inspection of the organ. The examination of the external ear is readily accomplished in its normal state, by inclining the patient's head to the opposite side, directing the ear to the sun or a strong light, and converting the curved passage of the meatus into a straight one, by drawing the auricle upwards and outwards, whilst the tragus is pressed outwards. When, however,

the external ear is the seat of morbid changes, it will be necessary for this purpose to use a speculum, such as is recommended by Kramer, by which, with the aid of sunlight, or that reflected from a mirror, the membrana tympani and meatus may be minutely examined.

The examination of the internal ear, with a view to diagnosis, was practised by Sabatier, Wathen, Douglas, Saissy, Itard, and others, by means of metallic tubes introduced into the guttural orifice of the Eustachian tube, and injections of tepid water; the sensations thus produced formed the basis of diagnosis in several cases. Of late years, the mode of exploring the internal ear has been much improved by introducing air instead of water, the idea of which first originated with Cleland, and has since been extensively practised by Deleau and Kramer. The latter authors, especially Deleau, have by these means applied with great success and ingenuity the principles of auscultation to the investigation of diseases of the internal ear. For the purpose of operating, Deleau recommends that an elastic catheter be introduced into the Eustachian tube, although Kramer considers that the usual inflexible metallic instrument in general use answers every purpose. The following are the directions for proceeding with the investigation given by Kramer, air having been previously compressed in an appropriate apparatus. "After the catheter has been introduced into the Eustachian tube, and fixed by means of the frontlet, the patient is placed close to a table, on which he leans the elbow next to it, and in this position he holds with the hand of that side the pipe of the air-press previously filled with compressed air. The operator then introduces the metal beak of the pipe into the funnel-shaped dilatation of the catheter; applies his ear close to that which is under examination; opens the cock of the machine; and listens to the sound made by the air rushing into the middle ear: when the Eustachian tube and cavity of the tympanum are perfectly free and open, the air flows in strokes without interruption, and with an audible shock against the membrana tympani. When the first shock of so strong a stream of air is over, or if it be not very violent, we hear, during the continuance of the streaming in of the air, a blowing and rustling in the ear of the patient, which appears to issue out of the auditory passage, and to fill his ear in its whole extent." The variations from this sound are morbid, and furnish indications, more or less distinct, of diseased changes in the organ, although, in order to judge of these correctly, it is necessary to pay attention to the force with which the air enters, and be somewhat skilful in the manipulation of the necessary instruments. Deleau has denominated these sounds *bruit de pluie*, *bruit de pavillon*, *bruit de la ciasse*, &c., to distinguish which great experience is required. For a more particular account of them, however, we must refer to his work (*Mém. sur le Catheterisme de la Trompe d'Eustache.*) If the air-douche does not penetrate into the cavity of the tympanum, it will be necessary to explore the Eustachian tube by means of catgut bougies. It is proper to state, however, that such modes of investigating diseases of an organ of such delicate and minute structure can be with safety undertaken by those only who are intimately acquainted with minute anatomy.

The different forms and varieties of otitis may for the most part be readily diagnosed by uniting the above means of investigation with a study of the symptoms presented by each. External is recognised from internal acute otitis—1. by ocular examination of the external meatus; when, in the former, the appearances previously described will be observed, while in the latter there is nothing abnormal; 2. by the discharge in the former occurring from three to thirty-six hours after the commencement of the symptoms, and increasing gradually, while in the latter, it seldom appears before the sixth day, and then takes place suddenly from the external auditory canal, or either suddenly or gradually into the throat.

When describing external otitis, we gave the diagnostic signs, which, according to Kramer, distinguish the different kinds of inflammation from each other. Primary inflammation of the membrana tympani may be distinguished in the acute stage by the red, swollen, and opaque appearance it presents; and at a later period by its being thickened, perforated, and giving rise to a purulent discharge, or being

more or less covered with fungous excrescences. It may be known from internal otitis by the above appearances at the commencement of the disease, and the milder nature of the symptoms. Kramer is of opinion that this primary inflammation of the membrana tympani constitutes the disorder generally termed earach, and has been mistaken for pure nervous otalgia. Mr. Pilcher also points out the importance of distinguishing inflammation of this membrane, as the introduction of opium and other narcotics, which will benefit pure neuralgia, will here increase the excitement (p. 178), it is only to be detected by examination. The blennorrhæal inflammation of the internal ear is to be distinguished from the other varieties of otitis by dullness of hearing, without pain or any discharge from the external meatus, and the presence of a gurgling mucous noise (*bruit muqueux*) on the introduction of the air-douche into the cavity of the tympanum. Inflammation of the lining membrane of the Eustachian tube may be suspected from the occurrence of deafness to a greater or less extent, with irritations in the throat, without pain in the ear unless it be complicated with some of the other varieties of the disease. It can only be positively diagnosed by using the catheter, which will also determine the amount of constriction or obliteration in the tube.

In the chronic form of the disease, it is important to determine whether the membranes alone are affected, or whether the bones are also involved. In the former case, the matter is of a yellowish purulent appearance, more or less abundant, and of greater or less consistence; in the latter it is always thin, grayish, or of a dirty colour, more or less sanguinolent, staining a silver probe, and exhaling a peculiar odour, generally denominated *carious*. It is also sometimes mixed with small bony fragments, the irregular form, and rough surfaces of which, render them easily distinguishable from the small bones of the ear. In some cases, examination of the external canal will enable the practitioner to see the denuded bone.

It is of great importance, with a view to prognosis, to determine whether the stapes is present or absent, which can only be done with certainty when the membrana tympani is absent. This is not easy, "on account of the obliquity of the cavity, and of the little bone presenting only its small head, being deeply seated, and thrown into shade by the projecting promontory. A little glistening spot may, however, generally be recognised above the anterior part of the promontory, which is the head of the ossiculum, whereas, were it absent, a dark spot would occupy that point." (*Pilcher*, p. 273.)

Caries of the mastoid process may be suspected when, in conjunction with the peculiar discharge, there is a fixed dull pain in that portion of the temporal bone, increased on pressure. When a fistula exists, examination with a probe will remove all doubt.

It is important to distinguish the congestive symptomatic cephalalgia, occurring in the course of otitis supervening on the suppression of the discharge, from the headach and cerebral symptoms symptomatic of inflammation of the brain, or its membranes, either primary or consecutive. This is only to be effected by inquiring carefully into the history of the case. In the former, there is deep-seated throbbing pain in the middle of one side of the head, with great tenderness of the scalp; in the latter, there is a sense of constriction, without tenderness of the scalp, while the fever, delirium, injection of the face and conjunctiva, are more intense than in the former, and the increase of the symptoms at night, and exacerbations are not so well marked. It must be remembered, also, that inflammation is more liable to occur in conjunction with caries of the bone, than when otitis is limited to the membranes. On the whole, however, it must be confessed that the diagnosis is by no means easy at the commencement, although at a later period, should there be convulsions, paralysis, rigidity, or coma, it will be comparatively less difficult. The symptomatic headach from otitis may be distinguished from the other varieties of cephalalgia by the severe pains in the ear, and the violent noises which are heard in the affected organ; symptoms which are increased on mastication and sudden noises. The fever, restlessness, and delirium, if present, are always increased at night. Irritation in the throat, and swelling of the tonsils, combined with the above signs, will throw further light upon the diagnosis. In all cases, the

ear and throat should be carefully examined, as otherwise, from the ignorance of the patient and his friends of the connexion between the head affection and local disease, the latter may be entirely overlooked, and a line of treatment adopted which will increase rather than diminish the affection.

Prognosis. All discharges from the ear, more especially if chronic, should be looked upon in a very serious light, inasmuch as they not only tend to destroy the sense of hearing, but are liable to induce structural alterations in the brain and its membranes. The opinion we may form of the disease, therefore, will have reference to two points; first, the influence it may produce on the sense of hearing; secondly, the greater or less amount of danger, as regards the life of the patient.

The prognosis, as to the curability or alleviation of the deafness, which may exist to a greater or less extent, will be derived from the history of the case, examination of the organ, and the symptoms which indicate in a negative manner that the disease has not extended to the tympano-vestibular membrane and the labyrinth. Examination of the external ear, by the means previously detailed, will determine whether the deafness depends upon some mechanical obstruction in the auditory passages, or upon the destruction of those parts essentially concerned in the function of hearing. In the first case, the prognosis will be favourable, if the obstruction be caused by the accumulation of pus, wax, crusts, &c., or growths which are susceptible of being removed or perforated; and unfavourable, when incurable strictures, or callous cartilaginous growths have permanently diminished or obstructed the calibre of the external meatus or Eustachian tube. In the second case, the practitioner must endeavour to ascertain whether any or all of the tympanal bones have been discharged. If the stapes still adheres to the membrane of the fenestra ovalis, hearing may be only impaired, from a deficiency in the conducting apparatus, and sonorous vibrations may still be conveyed distinctly to the labyrinth, by the solid parts of the head. If the stapes, however, have come away, it is probable that the vestibule is laid open, the sac eroded, and the water it contains in a healthy state has escaped. This is attended with irreparable deafness in the organ, as the nervous apparatus necessary to receive the impressions of sounds, and conveying the influence they produce to the brain, will then be so injured as to have lost its function. In the former case, the ticking of a watch is distinctly heard when placed between the teeth, and there is every reason to assure the patient that much may be done to improve his condition by a judicious treatment. When the labyrinth, and consequently the sentient part of the organ, has been destroyed, it is better to inform the patient at once that the deafness is incurable, than to make vain attempts to ameliorate his situation.

Treatment of Acute External Otitis. The local means necessary in this variety of the disease are for the most part such only as are capable of removing irritation from the external canal; as the application of poultices and the injection of tepid and emollient fluids. For this purpose, Kramer recommended a syringe three inches long, which contains an ounce and a half of water, and is furnished, anteriorly, with a pipe three quarters of an inch long, having an opening wide enough to give passage to a strong stream of water. The introduction of other substance into the meatus, as camphor wrapped up in cotton, recommended by Itard, or narcotic tinctures and preparations, as advised by some other authors, are more injurious than beneficial. Should the external meatus feel hot and burning, with swelling of its lining membrane, warm fomentations should be assiduously applied to the ear and side of the head affected, and at the same time a number of leeches behind the auricle. This treatment should be combined with the administration of purgatives, antimonials, pediluvia, and antiphlogistic remedies, which should be employed with greater or less activity, according to the severity of the symptoms. Derivatives may also be applied to the nape of the neck or behind the ear. With this view, Kramer much prefers the tartar emetic ointment rubbed on the mastoid process to blisters, which he thinks are only useful in circumscribed inflammations of the meatus or membrana tympani.

If there is much redness in the auditory passage, without vesicles, or if the membrana tympani be the chief seat of the inflammation, Kramer recommends injections containing the acetate of lead; and for this purpose uses a solution varying from one to ten grains of the salt to an ounce of water, which should be used two or three times a-day. If there be great swelling, and redness of the external meatus, with fever (*phlegmonous inflammation* of Kramer,) endeavours must be made by general or local bleeding, and other suitable antiphlogistic remedies, with a rigorous diet, to induce resolution. Should these not succeed, however, and an abscess form, its suppuration must be favoured as much as possible by warm emollient poultices, applied night and day, until the tumour bursts, and they should be persisted in, combined with warm fomentations and injections, if the pain continue. If the discharge at a subsequent period become offensive or fetid, a few drops of pyrolignous acid or of chloride of lime to an ounce of water is to be employed as a lotion.

As soon as the first acute symptoms have subsided, the attention of the practitioner should be directed to the removal of the cause of the disease. If it depend on the extension of porriginous, herpetic, or exanthematous affections, the remedies applicable to the cure of the original diseases should be employed and perseveringly continued, in conjunction with the local means above described. Fungous growths should be removed, if possible, torn wholly from their attachments, and the bases touched with caustic, care being taken, however, that this does not occasion too much irritation. When the excrescences in the ear are hard, with a broad base, Kramer has found incisions and cauteries useless, and considers them incurable. When insects enter the canal, a little fresh olive oil is to be dropped in, for the purpose of killing them, after which they may be easily washed out, or removed by the forceps. When foreign bodies have got into the ear, they must be removed by appropriate surgical means, care having been first taken to subdue the inflammation, if it have proceeded so far as to render the canal too sensitive to bear the contact of any instrument.

As the disease becomes more chronic, and all fever and local pain disappear, slight astringent injections may be used, and their strength cautiously increased, in the manner to be described in the treatment of chronic otitis. In all cases, however, these should be immediately suppressed if they induce the slightest irritation, or threaten a return of the disorder. Our chief reliance must at this period be placed on improving the general functions, especially those of the stomach and bowels, change of air, and such means as promote the healthy action of the different organs in the economy.

2. *Treatment of Acute Internal Otitis.* The acute internal otitis requires more active treatment than the external form; general depletion should be employed to a greater extent, so as to make a marked impression on the system. It will be generally necessary to employ afterwards cupping or the repeated application of leeches behind the ear, should the local pain continue. At the same time, an active purgative should be administered, and after its operation, antimonials every three or four hours, so as to keep up a state of nausea, and prevent a return of the general excitement. These remedies, if employed at an early period, will generally afford considerable abatement of the symptoms. Indeed, a large general bleeding alone has been often known to cut short the disease. On the second or third day after this treatment has been pursued, should the acute symptoms be evidently diminished, a blister may be applied behind the ear or at the nape of the neck. But should these means from having been employed too late, or from other causes, not induce resolution of the acute symptoms at the end of four or five days, and the sufferings of the patient be undiminished; if there be throbbing pain, with a bursting sensation in the ear, general headach and delirium, we may infer that suppuration has taken place. Under such circumstances, ulceration will for the most part take place spontaneously in the membrana tympani, and the discharge of matter will in most cases be immediately followed by considerable relief. Should this not occur, however, before the sixth or seventh day, it is desirable that the membrana tympani, should be punctured, as the long

confinement of matter in the cavity, mixed more or less with air, may, from its being insinuated into the mastoid cells, give rise to caries, or at all events induce a spontaneous laceration of the membrana tympani, that may be highly injurious. The evacuation of the matter, whether spontaneous or artificial, should be immediately followed by the injection of tepid fluids, in order to favour its discharge. The practitioner should then be careful in preventing any obstruction to its free exit by the use of tepid and emollient injections two or three times a-day. The patient, also, should be directed to sleep on the affected side of the head, in order that the matter may not accumulate in the cavity of the external or internal ear. In all cases, the throat should be examined, and if there is swelling or irritation in the tonsils or posterior fauces, gargles, containing the suborate of soda, the nitrate of potass, or the hydrochlorate of ammonia should be used; or such as are more astringent, formed of the decoction and tincture of bark, muriatic acid, &c. These gargles should be employed in such a manner as to strike with violence the affected part, in order to remove, as much as possible, any concreted matter which may adhere to the throat, and obstruct the extremity of the Eustachian tube. Itard recommends that the vapour of warm water should be inspired and expired with force, while the mouth and nostrils are shut. It is rare, however, that by such means obstruction is overcome; recourse must therefore be had to aqueous injections, as advised by Saissy, Itard, and others. The air-douche is preferred and practised by Deleau and Kramer. Should these not succeed, catheterism, performed by a skilful operator, may be attempted; and if the tube be found completely closed from disease, farther efforts will tend rather to increase than diminish the evil. It will be proper, also, that such general measures as are calculated to assist in removing the disease be at the same time adopted. Itard speaks favourably of sternutatories, but their utility is very questionable, and if the patient is liable to headaches, they are dangerous. As the affection becomes chronic, the remedies, to be advised under that form of the disease are to be employed.

With a view of relieving the blennorrhœal form of internal otitis, recourse must be had to the air-douche. If a small mucous rale is heard on applying the ear to that of the patient, during the streaming in of the air, followed by a material improvement in the power of hearing, which is readily ascertained by the watch, it should be used daily; and if the mucous rale changes to a gurgling sound, and the patient's hearing becomes more distinct after each sitting, there is every hope of curing the disease. Should no sound be heard, however, or no improvement in the sense of hearing take place after the fourth sitting, Kramer lays it down as a rule that the attempt should not be persisted in. Injection of fluids, as warm water, or a saline solution, has also been employed, but those in general are not so beneficial as the air-douche. In this variety of the disease, also, catheterism of the Eustachian tube may be often necessary.

3. *Treatment of Chronic Otitis.* The difficulty of curing chronic otitis will be in proportion to the length of time it has been established, and the amount of destruction produced in the membranous or osseous structures of the organs of hearing. Before commencing the treatment, the practitioner should pay considerable attention in all cases to the appearance of the discharge, and examine with care the external auditory canal, the parts surrounding the concha, the region of the mastoid process, and the interior of the mouth, soft palate, and amygdalæ. In all endeavours, moreover, to cure or alleviate the disease, it should never be forgotten that, when the malady has existed some time, the system becomes habituated to the discharge, and that, in proportion as the disease assumes a more chronic character, the greater is the danger from hastily suppressing it. In cases of long standing, the utmost caution is necessary to avoid the serious complaints that are apt to follow when the discharge suddenly lessens or disappears.

The *general* treatment is of great consequence, and should be steadily continued, in order to place the system generally in such a state as to favour the action of local remedies. If the affection have been induced or be kept up by

chronic eruptions in the neighbourhood of the ear, the use of warm or medicated baths, change of air, the internal exhibition of sulphur, mercurials, antimonials, sarsaparilla, and other alteratives should be employed. When the disease is connected with a syphilitic taint, the line of treatment necessary for treating the original affection should be adopted. When it is connected with serofula, the preparations of iodine, such as the ioduret of iron, or the proto-ioduret of mercury, may be used alone, or in combination with the infusion or decoction of cinchona, or preparations containing quinine, tartarized iron, and other tonics. In some cases, it is of importance, by a nutritious diet, combined with exercise, judiciously regulated, to prevent the quantity of the discharge from producing a depressing effect on the system, while precautions should be taken to prevent the head, ears, or feet, from being exposed to cold, or changes of temperature. At the same time, vinous and spirituous liquors should be abstained from, and all stimulating articles of diet that may prove a source of irritation to the digestive organs carefully avoided.

The *local* treatment should be at first confined merely to the introduction of tepid water injections, until the practitioner, after a use of the remedies above mentioned, is assured of the general good state of the patient's health. This treatment should be persisted in for some time, at least four or five months in cases of old standing; although when the disease is comparatively recent, the treatment by injections, to be noticed immediately, may be at once adopted. If there is a spongy condition of the external meatus, tents of lint, dipped in a solution of the acetate of lead, may be introduced into the passage, as recommended by Kramer, the pressure of which is useful in producing a disappearance of the excrescences. Should the discharge at any time become considerably diminished, or cease suddenly, every effort should be made to induce its return, especially should it be followed by cerebral or other serious symptoms. For this purpose, warm fomentations to the ear, and hot poultices, should be applied. Itard recommends the application of a loaf which has just left the oven, the crust on the side which is applied to the ear having been previously cut off. These means will in the majority of instances succeed. If, after the adoption of general treatment for some months, with the use of emollient injections once or twice a-day, the discharge remains stationary, and especially if it have gradually diminished without any previous acute symptoms, the practitioner may proceed to lessen the discharge, and cure the chronic morbid action by resorting to a more active local treatment. Itard recommends that this should be accomplished with great caution, a maxim that in our opinion it is of the greatest consequence to attend to, as an attempt to hurry the cure, and induce a too sudden diminution of the discharge, may not only induce metastasis, but delay the recovery, and render it again necessary to go through a preparatory treatment. In several cases which have come under our observation, where this advice was not sufficiently attended to, we have seen acute symptoms come on, which in some were followed by earies, and the worst effects of the disease. We have observed also, that not a few patients labouring under otorrhœa have attributed their most serious complaints to the application of a blister or seton. On the other hand, when the medical attendant considers that attempts to check the discharge, and diminish the morbid action producing it, may be tried without danger, he should exchange the tepid and emollient injections for those which are astringent in the mildest degree, and such as are more and more powerful should be successively and cautiously used. A weak and tepid infusion of chamomile flowers or rose leaves should be employed to commence with and continued several weeks, and the strength of these may then be gradually increased, rather than have recourse to stronger astringents. After a time such injections may be used cold, and subsequently a weak solution of the sulphate of zinc, or acetate of lead, may be employed, and its strength increased by degrees. Solutions of alum and nitrate of silver may also be employed. Months, however, should be occupied in this treatment, and the greatest care taken not to hurry on the cure, either from impatience on the part of the patient,

or want of resolution on that of the practitioner. Whenever the discharge diminishes too abruptly, the astringent injections should be for a time suspended; and should it cease suddenly, care must be taken to solicit its return by the methods previously mentioned, more especially if there should be the slightest threatening of acute symptoms. When this has been difficult, Itard has succeeded in one case by the use of the warm bath for three hours, and in another by applying a large cupping glass, so as to embrace all the concha and external ear. If, at the end of five or six months, the discharge has nearly ceased, and the patient suffers from no unpleasant symptoms, a small blister behind the ear or at the nape of the neck may be employed, and in a few days replaced by a larger one. At this period of the treatment we have found derivatives useful in completing the cure. Injections may be introduced not only through the external meatus, but through the Eustachian tube. When the practitioner, however, has not been accustomed to this mode of operating, he had better inject by the former opening, as otherwise he is very likely to bring on acute symptoms.

If by the means now recommended the discharge should after a time permanently cease, a little cotton should be worn in the ear for a short time, in order that the parts may recover their tone. This must be worn continually if total deafness be the result of the disease; but if this be only partial, and the membrana tympani is not wholly destroyed, recourse may be had to such mechanical contrivances as are best suited to assist audition. If on the other hand the disease proves inveterate, and no benefit is derived from astringent injections, combined with appropriate general treatment, the efforts of the practitioner must be directed to keeping the parts clean, and favouring the discharge by emollient and simple injections. By attention on the part of the patient, although the disease cannot be cured, its destructive progress and termination in caries may be prevented. Dr. Burne alludes to the case of a woman seventy years of age, who had been affected with otorrhea from both ears, and deafness, since she had the scarlet fever in childhood, and who by the daily injection of warm water had preserved the organs from farther disorganization. (*Cyc. Pract. Med.*)

We have laid great stress on the necessity, in chronic otitis, of acting cautiously and slowly, especially when it extends to the tympanum, being convinced that many of the inveterate cases met with in practice result from the ill-directed and hasty efforts made to effect a speedy cure of the disease by the injudicious use of too astringent injections, and the early employment of blisters, setons, &c.

In otitis with caries the same general treatment is to be followed as has been described, more particular attention being given to support the strength by tonics, antiseptics, and a nutritious diet. Should the discharge issue from the external meatus the same tepid and emollient injections should be frequently used, and every thing that obstructs the escape of matter carefully removed. If the matter is fetid, or of a disagreeable odour, a few drops of pyrolignous acid or chloride of lime, in an ounce of water, used as an injection, will correct it. A probe should be cautiously introduced, and if loose pieces of bone are felt slightly attached, their separation should be favoured as much as possible by slight pressure with the instrument, or if they can be reached with the forceps, extracted without force. When caries affects the external meatus, and the diseased bone exfoliates, the healing of the ulcer is very liable to be followed by obliteration of the passage. Kramer recommends that when the parts show a tendency to close, touching the edges with lunar caustic is the best means of keeping them open. If the parts are already closed, they should be opened by incision, and the caustic employed to prevent re-adhesion. Hearing, however, usually remains more or less dull, partly because the natural form of the meatus is lost, and partly because the membrana tympani has participated in the inflammation. If a dull fixed pain have existed some time in the mastoid process, and the skin covering it become swollen and discoloured, we should not wait and allow an abscess to form, whereby much time is lost, and the caries rendered more extensive, but cut down on the bone at once, enlarge any small opening that may

exist in it, so as to permit the free escape of matter, and inject directly tepid water into the cells of the mastoid process. An opening even may be made in the bone, by a proper instrument, if the operator is convinced of the presence of matter in the mastoid cells. When, however, the matter points in the neck above the clavicle, the abscess should not be opened, as by so doing a troublesome fistula would be produced, and there would be no means of acting directly on the diseased part. In these cases we should use as early as possible such means as are most likely to cause absorption in the abscess, and by the methods previously detailed endeavour to promote a free discharge from the external meatus. The caries of the petrous portion of the bone can only be treated by emollient injections, until the diseased portion of the bone separates. To promote this, an appropriate general treatment is of great importance, in addition to which Itard directs frictions on the scalp, the head to be shaved and covered constantly with a gummed silk cap. Subsequently astringent injections may be employed as formerly noticed: some authors have recommended irritating and even caustic injections into the external meatus, to favour the separation of the carious bone, but Kramer, with whose experience our own coincides, states that they should be avoided.

When there is any evidence that the disease has extended to the cavity of the cranium, absolute rest is necessary, and none but the mildest injections should be employed to favour the flow of matter from the ear. If the patient be of good strength, and the symptoms of cerebral inflammation be well pronounced, active blood-letting and antiphlogistics are indicated. Purgatives are especially useful in this case, both as a means of removing irritation from the alimentary canal, and from their acting as a derivative. We have already alluded to the difficulty of distinguishing such cases, and they are often very embarrassing to the practitioner. If, as is very likely to happen, he is called in to treat the cerebral symptoms, he may overlook the local disease, and use depleting measures to an extent, that may afterwards, when the discharge returns, or becomes established, prove dangerous from having too much exhausted the powers of the patient. Dr. Burne states that he was once called in to a case that had been viewed and treated as idiopathic phrenitis, when he discovered a large abscess presenting behind the ear; it was opened, and discharged a quantity of most offensive pus. The patient was relieved, but she sunk from the copious blood-lettings that had been practised. (*Cyclop. of Pract. Med.*) More generally however this unfortunate termination of the disease supervenes on a long-standing otitis with caries, when the patient is more or less enfeebled by the continued discharge, or by the local irritation having for a length of time acted on a constitution originally scrofulous or delicate. Under such circumstances the cerebral disease must be combated by derivatives, such as blisters or the tartar-emetic ointment applied to the scalp or nape of the neck, while the excretions are to be properly regulated, and tonics, a nutritious diet, and such means employed as may support the sinking powers or the patient.

DISEASES

OF

THE ORGANS OF RESPIRATION.

ON THE DIAGNOSIS OF DISEASES OF THE LUNGS.

General observations.—I. Examination of the chest through its physical properties—by sight and touch—by mensuration—by its sounds—by percussion.—Sounds of the respiration.—Rhonchi.—Sounds of the voice.—Mode of employing auscultation.—Comparative advantages of immediate and mediate auscultation.—Principles and construction of the stethoscope.—II. Examination of the chest through the vital properties or functions of its organs.—Analysis of the general symptoms.—Dyspnœa.—Cough.—Expectoration.—Pain.—Symptoms connected with the circulation.—Analysis of the pulse.—Symptoms from the venous and capillary circulation.—Of the symptomatic fever.—Respective value of the physical signs, and general symptoms.

THE knowledge which we possess of the pathology and diagnosis of diseases of the respiratory organs, and consequently of a rational method of treating them, is so entirely of modern origin, that it would be useless in a practical work to refer to the writings of past ages for information on these subjects. The essential phenomena and the products of disease were until lately too little understood even to be described accurately; hence the descriptions and names of the older writers, however minutely given and dogmatically applied, are vague and equivocal to the modern reader.

The great improvement that has taken place of late years in our knowledge of diseases of the chest, and consequently in their treatment, has mainly arisen from the careful cultivation of pathological anatomy, and the successful application of physical means of diagnosis in connexion with it; in both these departments, especially the latter, we must give the pre-eminence to Laennec, whose *Traité de l'Auscultation Médiate* may be regarded as at once the *novum organum*, and the *principia*, of our knowledge of thoracic diseases. The results and the means of his discoveries have been so far extended and improved by subsequent investigators, as to have changed the subject from being one of the most obscure to be among the most intelligible in practical medicine. It was the defect of Laennec's practice to trust entirely to the physical signs, often to the exclusion of the general symptoms, which are always, especially in regard to the treatment, of the utmost importance. Both sets of signs have their value, and it will be our especial object to point out the modes of appreciating each in the study and treatment of the special diseases; to show, as far as is possible, their relative value, by examining them more fundamentally than has generally been done; and, whilst we pay due respect

to authentic records of experience, of whatever kind, to make them still more profitable and instructive by careful analysis and generalization. It is necessary, however, to study the structure of the pulmonary apparatus; the form, position, and connexion of its several parts; their relation to physical laws, and the combinations of these laws in their statical and dynamical forces, that is, at rest and in motion. But in doing this it is soon discovered that the object of our study is more than a mere machine, and that it possesses properties, and is governed by laws which are not met with in inanimate matter. We have the *vital properties*, *sensibility*, *irritability*, *contractility*, added to the mechanism; we have a *vital chemistry* pervading the materials. Besides the chest, which is mechanically enlarged and diminished, and the lungs and their tubes, which are at the same time expanded and compressed, and the heart and its hydraulic pipes through which liquid is propelled, there are, also, in these several parts, the *vital* properties, which not only bind them together in special and complex relations, but connect them also with other organs and members of the body. Here, again, we see the sources of the two classes of signs of health or disease: the *physical*, confined to the organs and their physical or mechanical properties as exhibited in these organs; and the *vital* or *general* symptoms, the result of vital properties, which are not confined to the part, but may extend their operation and seat over the whole frame. Now, as in the maintenance of health, and in the production or removal of disease, each set of properties is concerned both as causes and as signs, so the necessity of duly appreciating both classes must be apparent.

It being presumed that the reader has studied the anatomy and physiology of the general structure, functions, and relations of the chest and its organs, the next object is to become acquainted with the signs or symptoms, through which, in the living body, we can judge of the condition of the various parts of the structure, and of the performance of their several functions, and thus, through which, we can distinguish health and disease. The condition of the chest and its organs may be examined through two classes of properties, the *physical* and the *vital*. The physical properties are studied, especially through vision, tact, and hearing. The vital phenomena are studied in the condition of the functions, which are complex properties, or actions dependent on vitality operating in physical structure.

I. PHYSICAL EXAMINATION OF THE CHEST.

We examine the chest physically through those properties of form, size, proportions, relative position and density of its parts, at rest and in motion, which are appreciable by our external senses. To assist this examination we must previously possess a good general knowledge of the topography of the several organs within the chest; we must know where each severally lies and reaches with regard to the exterior; so that, when we inspect, feel, or listen, at the different regions of the chest, we may define the general outlines of the organs within. This knowledge must be acquired by personal observation, which should be exercised both on the dead and on the living body. In examinations after death, the position of the organs with regard to the exterior should be observed. The moment the sternum is raised, and before the lungs collapse (which may be prevented by closing the nostrils,) the extent to which these organs cover the heart and reach downwards, the position of the air and blood-vessels, the height of the diaphragm, and of the abdominal viscera beneath, should be noticed by the student; and he can transfer these various sites to the marks or lines of the exterior, such as the nipples, the edges of the pectoral muscles, the number of the ribs. This habit of comparing the outside with the inside of the chest in the dead body may not, however, furnish a perfect knowledge of what exists in the bodies of the living; for besides that there is much variety in different individuals, there may, on the cessation of the motions and properties of life, be some changes in the size and condition of the organs, and these changes may vary

according to the mode of death. Thus it is probable that the diaphragm, relaxed by death, permits the abdominal viscera to encroach on the cavity of the chest farther than during life; and the volume and position of the heart and lungs will be affected, not only by this circumstance, but by the condition of the circulation and respiration at the time of death, by the influence of time and temperature on the stiffening of the muscles, and by other changes which immediately succeed death, such as the disengagement or absorption of gases by which the intestines are distended, which vary much in different cases. It is well to be aware of these modifying circumstances, which can be appreciated only by the habit of personal observation: and it is by such individual experience, rather than from rules and descriptions, that a knowledge of the topography of the organs can be obtained in the study of the dead body.

Examination of the Chest by sight and by touch. The other mode of studying the topography of organs is more exact, but more difficult. It is the personal habit of physically examining the living body. The patient standing, or even sitting, with his arms, trunk, and legs in symmetrical positions, and his chest, if possible, entirely uncovered, and exposed to a good light, we view it in front, behind, and from above, and carefully mark its form and proportions, and the corresponding prominences and depressions of the two sides. A healthy chest is nearly symmetrical, the two sides corresponding in shape and size. The right side is, however, almost always slightly larger than the left, especially at its lower portion, where the difference of measured circumference generally amounts to half an inch. This preponderance in favour of the right side is partly to be ascribed to the contents, the unyielding mass of the liver; but it is probably also connected with a law which pervades the animal creation, giving a superiority of strength and development to the right side. It is supposed by Dr. Stokes and M. Woillez, that the increased development of the right side is rather a consequence than a cause of the greater strength, and consequent use of its muscles; and they say that the proof of this is seen in the exceptional cases of left-handed persons, in which the left side has a superiority in size. We have observed, on the other hand, in most healthy chests, an advantage on the left side in point of height: the apex of the left lung, and corresponding portion of the chest, rise a trifle higher than those of the right. We are not prepared to say whether this be an original conformation, or whether it result from the habitual inflation of the stomach, and the unyielding mass of the heart on the left side giving the chest a greater tendency to upward expansion. When these slight exceptions are known, they will not mislead, and they scarcely detract from the general symmetry of the chest. Whenever there is any considerable departure from this degree of symmetry, or correspondence between the two sides, it becomes pretty certain that there either is, or has been, disease.

It has been stated that the chest should be viewed from *above*, as well as from before and behind. This may be done when the patient is seated on a low seat, with the head a little inclined forward, the observer standing behind or on one side, and looking down on the shoulders. A view is thus obtained of the depth of the chest from front to back, and in this way may often be detected between the two sides a want of correspondence, that is not perceptible by the ordinary modes of inspection. If the patient's strength do not permit him to stand or sit up, the chest may be inspected when he is lying on his back, and this may be done by the observer taking his position, not only at the side, but also at the foot and at the head of the bed; from which the corresponding parts of the two sides can be better seen.

The inspection of the chest is to be applied not only to its statical condition, but also to its motions; and here it is proper to combine manual examination. Whilst, therefore, we are inspecting the chest, we desire the patient to breathe in various degrees; and with the hands and eyes directed to corresponding points of the two sides, we watch and feel the amount and equality of the motions. If the chest is a healthy one, we see the motions as uniform as the chest is sym-

metrical: the clavicles, scapulæ, and upper ribs rise; the lower ribs rise and spread; and the abdomen swells, as the diaphragm descends at each inspiration. Attentively watching and feeling the chest will often also enable us to trace the limits of some of these movements, so as to indicate the boundaries of the chest. Thus the lower ribs are pressed outwards by the displacement of the abdominal viscera at each descent of the diaphragm, and constitute a fulness below the limits to which the lungs descend, with a slight flatness or hollow above. These appearances have been pointed out by Dr. Edwin Harrison, as visible indications of the height of the diaphragm and liver. The intercostal spaces and the hollow above the clavicles are also fit marks for this mode of comparison between the two sides. They are strongly marked during full inspiration; and are liable to be more so than usual where the entry of air into the lungs is difficult from obstruction of the tubes, and less so than usual when the obstruction is more in the tissue of the lung from internal effusion or external pressure. There are many other useful details which are soon learned by practice, when the principles of the examination are properly understood. Applying the hand on the region of the heart, we feel the relation of the respiratory motions to that organ. After a full expiration the heart is felt beating about the cartilages of the third and fourth ribs, as well as under the sternum; but as the ribs rise, and the lungs expand by inspiration, we gradually lose the beating; and if it be felt at all, it will now be low as the sixth rib.

There are some general varieties of disordered respiration, which are determined by watching and feeling the motions of the chest. Healthy or perfect respiration is both diaphragmatic and costal; but under the influence of disease the motions may be imperfect, and confined either to the ribs or to the diaphragm. Thus, when the diaphragm is prevented from descending by acute pain in it or below it, or by pressure from below, the respiration is wholly performed by the raising of the ribs; and is called *heaving, thoracic, or costal* breathing. When, on the other hand, the ribs are immovable in consequence of pain, ossification of the cartilages and ligaments, or paralysis of the intercostal muscles, the breathing is wholly *diaphragmatic or abdominal*.

The movements of respiration may be *partial*, while one side of the chest is seen to move much less than the other, or when part of one side moves imperfectly; and this partiality of movement may have its cause in the walls, or, as more usually, it may proceed from impermeability of the corresponding portions of lung, in consequence of various diseases. Thus, when lymph or tuberculous matter in the tissue of the lung, an obstruction of the bronchi, an effusion into, or a contracted adhesion of the pleura, prevent the inflation and collapse of a part of the lung, the corresponding walls of the chest will be resisted in their motions, and will be fixed in proportion. Thus in phthisical patients we often see the ribs below the clavicles scarcely moving in respiration, and often sunk on one side: in pneumonia and pleurisy, the lower ribs are more commonly fixed. It is proper to mark farther how they are fixed; whether in a state of dilatation, or in one of collapse; whether the affected part remains full after expiration, or is still sunk after inspiration, or whether it is fixed in an intermediate state: we may thus, in certain instances, go some way to distinguish between the different causes of pulmonary obstruction.

Mensuration of the chest is a more exact method of detecting inequalities between the two sides. It is generally practised by fixing with the finger a piece of tape by one end at the mesial line of the sternum, and passing it horizontally around the chest to the same point; then, by taking it off at the point where it crosses the spinous process of the dorsal vertebra, the length of two sides may be at once compared. Great care must be taken to pass the tape horizontally around corresponding parts; and attention should also be paid to the degrees of the respiratory act. The most accurate mode is to compare the measurements of the two sides, on a full inspiration and expiration as well as in the intermediate state. Dr. Stokes recommends the use of graduated callipers to measure the

depth and height of the chest, as well as its circumference, which alone is given by the tape. Such an instrument would doubtless afford more exact results; but it is not likely to be introduced into general use. We may mention that we have been in the habit of using the tape for the height also, by measuring from the bottom of the sternum to the hollow under the humeral end of the clavicles, and from the latter spot to the spinous process of one of the lower dorsal vertebrae. The measurement may also be practised from the top of the sternum downwards and outwards, to the margin of the ribs at either side. These expedients, together with the practice of inspection downwards on the shoulders for the antero-posterior diameter of the two sides, are generally sufficient to furnish the comparative dimensions of the sides of the chest.

Besides external measurement, which is essentially comparative between the two sides, there have been various attempts to measure the internal capacity of the chest by noting the quantity of air that can be exhaled or inhaled. The late Mr. Abernethy proposed to judge of the capacity, and thereby of the soundness of the lungs of a patient, by measuring how much air he could throw at a breath after a full inspiration into a jar inverted over water. Other contrivances have been made to measure how much air can be inspired at a breath from a jar of air inverted over water. The chief objection to these means of measurement is, that their indications are affected not only by the capacity of the lungs, but also by the strength of the respiratory efforts. They are dynamometers for the muscles of respiration as well as pulmometers; and a weak, delicate, or nervous person, with sound lungs tested by them, would be placed below a pleuritic or phthisical patient whose muscular energies are still considerable.

So much for examination of the form, shape, and size of the chest by sight, touch, and measurement. It may often give us important indications; but it will seldom inform us of the nature of the obstructions or changes which it discovers; and it cannot detect many obstructions and changes in their smaller degrees. The chest may be immobile, distended, or contracted in parts, but whether from impervious air-tubes, diseased lung, liquid or air in the pleura, or any other of the various causes, sight and touch will rarely inform us.

Examination of the chest by hearing. We are led, then, to try another sense which may reach beyond the surface, the sense of *hearing*. The acoustic phenomena of the chest should be studied, not only by mere experience, like that by which the infant studies objects by sight and touch, and in time becomes acquainted with them; but also, more rationally, by a generalization of such experience in the laws according to which the phenomena occur. We must accustom our ears to the sounds in all their varieties, that we may be able by experience to know and distinguish them; but to understand their import, and to read the interpretation which they give to the condition of the parts that produce them, we should study them through the laws under which they occur. We must consider what sound is, how it may be produced, transmitted, and modified; how the contents of the chest may produce it, and, when produced, can change it: and by comparing its general properties with the mechanism of the chest and its organs, we shall be prepared to understand and arrange the phenomena that experience has discovered, or may hereafter reveal to us. By thus learning the acoustic relations of the chest, not merely as isolated facts, but as parts of an applied science, we may be enabled to escape, in great measure, the errors into which unintelligible matters of memory might continually lead us, and we shall be acquiring a rational pathology, instead of resting on an empirical diagnosis.

The character of the present work precluding the introduction of more than a few of the leading principles with regard to sound in general, we must refer for farther details to the various treatises on natural philosophy, and to the lectures and treatises of the writer on the physiology and diseases of the chest.

Sound is a certain velocity of motion of a body, or of the particles of a body, resisted with a certain force. The moving and the resisting forces acting alternately in opposite directions, constitute the vibrations of sound, which may be-

seen in a vibrating cord, and illustrated by the slower motions of a vibrating pendulum. The transmission or conduction of sound is the communication of the sonorous motion from one body to another, as one ball striking another ball moves it. The reflection of sound is the refusal or rejection backwards of this motion by bodies which cannot receive it, as a wall throws back the motion of a ball. Sound is most readily produced and sustained in bodies of uniform density and elasticity, the particles of which transmit and continue, and do not reject or choke each other's motions. Hence tense and rigid bodies produce and conduct sound better than those which are flaccid and soft. Bodies of very different density and elasticity do not readily receive sound from each other; because their powers of motion differ in force and extent, and must cause them to reflect or choke the motions which they receive from each other. Thus a sound produced by air is intercepted by a solid; and that produced by a solid is far better transmitted by a solid of the same density and elasticity, than by air. The sound of a body much more dense than air, such as metal, may be communicated with greater freedom to air by the medium of a third body of intermediate density, such as wood, and this effect may be increased by extending the surface, and lightening the mass of the third body, as it is done in the sounding boards of musical instruments. The note or pitch of a sound depends on the frequency of the vibrations, those of the highest or shrillest notes being the quickest. The duration of a sound depends on the continuance of the vibrations. The sources of sound are such impulses as those which affect bodies suddenly, or with some force. Thus the percussion, collision, friction, tightening and breaking of solids cause sound. Sounds are not often produced in air or in liquids but by the aid of solids, which either communicate the motion or offer the resistance: thus we hear the wind only when it whistles in a key-hole, in the rigging of a ship, the leaves of a tree, or the like; and the sound of wind instruments depends on the motion or on the resistance of a solid. But liquids and air together readily generate sound without the aid of solids, by their impulses on each other; and thus are caused all the bubbling and rushing noises of liquids, from the frothing of beer to the roar of a cataract.

Examination of the chest by percussion. As the nature of metal, wood, and other bodies is tested by the sound which they yield on being struck, so we strike or percuss the chest to judge of the nature and condition of its materials. The practice of percussion as a mode of diagnosis; we owe to Avenbrugger; it has been applied and improved by Corvisart, Laennec, Piorry, and others, and now constitutes an important mean of diagnosis in diseases of the chest and abdomen. When the principles on which its indications depend are well understood, the practice becomes easier as well as more instructive; and as we believe that no preceding writers have exposed these principles correctly, it will be well, after stating the general phenomena of percussion, to explain them by a few familiar illustrations.

The chest when struck abruptly with the ends of the fingers, yields a rather deep and not very short sound; which implies that the vibrations are not quick, and that they do not instantly cease. If we strike in the same manner on the thigh, a very different sound results, a short dull tap, implying that the vibrations have no continuance. The same dead tap is obtained on striking the lower part of the chest on the right side, where the liver lies; but all those parts under which the lungs are, yield more or less of the deep hollow sound. Is the seat of this sound in the air, or in the solids of the chest? If it be in the air, like that of hollow bodies, it ought to be changed by the same circumstances which modify the sounds in them. Thus, if we take an India-rubber bottle, and strike it, we find that its note is quite different when its mouth is open, from that which it yields when it is closed. But closing the glottis, or aperture into the chest, does not materially change the sound of pectoral percussion. Again, the sound of hollow bodies is deep in proportion to their size. Thus a large India-rubber bottle gives a much deeper tone than a small one; and its note is raised on diminishing its

cavity by compression. It is not so with the chest; for enlarging or diminishing its hollow does not in this way change its sound on percussion: the extremes of inspiration and expiration only slightly raise it.

As the sound of percussion of the chest does not follow the law which regulates sounds produced in the air of hollow bodies, we must conclude that it is seated in the solid: and if we study the construction of the chest, we shall see how well-adapted its solids are to vibrate. Composed of layers of membrane, thin muscles, and integuments stretched on an elastic frame of bone and cartilage, the walls of the chest are free to vibrate so long as the organs within do not check their motions; were there nothing but air within, these motions would be perfectly unembarrassed, and the sound would be more prolonged and hollow in consequence, deriving also an additional tone from the note of the cavity within, as in pneumothorax, or over an inflated stomach. The light, soft, spongy tissue of the lung scarcely interferes with the free vibrations of the walls, whilst the slight sound of its own which it yields, is equally deep with that of the walls with which it becomes combined. Hence, where healthy lungs lie in contact with them, the walls of the chest give a deep clear sound. But below the sixth or seventh rib on the right side, which is over the liver, and to the left of the lower part of the sternum, which is over the heart, the sound is dull and short, the vibrations being checked by these solid organs beneath; so it is obvious that morbid changes of the organs, such as a condensation of the lung, or the pouring out of serum into the pleural sac, would in a similar way arrest the vibrations, and render the sound of the chest dull in those parts where these changes occur. On the other hand, changes of an opposite kind, such as dilatation of the air-cells of the lungs, or an effusion of air into the pleural sac, may make the vibration of the walls more free than usual, and thus increase the sound obtained on percussion.

These illustrations are enough to show the general principles of the acoustic examination of the chest by percussion. It is a test of the density and elasticity of the materials within the chest: as diseases alter these qualities, so will they alter the sound on percussion which may thus announce their presence. A few more considerations will suggest some practical application of these principles. As we have seen that the walls of the chest give the sound which we hear on striking the chest, so it is plain that they must be sufficiently tense and elastic to vibrate on being struck. The chests of some persons are so loosely put together, and so flaccid, that they give but little sound, although the organs within are quite healthy. In others, again, there is such a mass of fat and loose integument on the chest, that the walls are completely muffled by it, and they sound but little on percussion. The same difficulty occurs, in other cases, in certain regions where muscles of considerable thickness, or the *mammæ* in females, lie on the walls. In other instances again, the walls of the chest are so drawn in by contracted adhesions of the pleura, that they are too tight to vibrate, and give a hard or dull sound, although the lungs within them may be comparatively healthy. In all these cases we must give to the part struck the equal tension which is wanting, by pressing on it a small piece of some firmly elastic body, such as wood, ivory, stiff India-rubber, or some such substance. This, when struck, gives sound enough; and if it be firmly applied to the chest, the density of the contents within will modify this sound, just as it modifies that of percussion on the naked walls of the chest. The sound obtained by striking a little plate of ivory or wood thus pressed on the chest, is the same in character as that of striking the chest itself: but it is louder, and as percussion on it gives no pain, the stroke can be applied with such force as to make the vibrations reach the interior through any thickness of fat or muscle. By these means we can test the sonorous qualities of the thoracic viscera through the scapulæ and the muscles of the back, and through fat or œdematous integuments of any thickness. In this way, too, we can try the resonance or sonorous quality of any part of the abdomen.

We owe this method of *mediate* percussion to M. Piorry, who calls this percussion-plate a *pleximeter*. Mediate percussion is so much better than the immediate

kind, that it is now generally preferred. There is, however, an improvement on it which was, we believe, first proposed by Dr. Skerret; it is to substitute for a pleximeter the fingers of the left hand. This mode of percussion has the advantage of convenience as well as of yielding distinct results. Its adaptations are soon found out by a little experience—in fitting the fingers to the inequalities of the chest, sometimes singly, sometimes together, sometimes with their palmar surface outwards, but generally with this applied to the chest and the back to strike on, with other varieties of manipulation to be hereafter noticed.*

To understand the varieties of sound of percussion, and their situations in the chest, it is necessary to bear in mind how the contents of the chest lie in relation to the surface. This varies considerably in different healthy individuals, but the following may be given as an average statement of the position of the thoracic organs after an ordinary expiration. The lungs are in contact with all the upper and middle portions of the walls of the chest. On the right side they reach down to about the sixth rib in front, and the eighth rib at the side, below which the liver comes in contact with the walls, and still lower in the back. On the left side they reach to about the seventh rib in front, except within two or three inches of the sternum, where they seldom reach lower than the fifth rib, there being a space of from one to two superficial inches under and to the left of the sternum, where the heart lies in contact with the walls; at the side they reach to the eighth rib, whereabout they are bounded by the stomach and spleen, which, with the colon, also bounds them behind, where they reach a little lower. Inspiration greatly alters these limits, both by raising the ribs and expanding downwards the lungs, which then reach a rib lower, and a full inspiration may bring them in contact with nearly the whole of the thoracic walls, while expiration has the converse effect.

The sound on percussion corresponds with this description, and by it we may therefore know the position of the organs in a living subject. Thus in all the upper parts of the chest, before, behind, and at the sides, the sound is clear, and equal on both sides. There is also some clear pulmonary sound in the inferior parts of the chest down to the limits to which the lungs reach. But below the fourth rib in front on either side, although the lungs are in contact with the walls of the chest, their lobes are not thick, and beneath them lie the liver on the right side and in front, and the heart and stomach in front and to the left. The vicinity of these organs modifies the sound on percussion, and the more so, the nearer they approach to the surface, where the lungs become thin towards their margins, until they quite give place to the peculiar sounds of these respective viscera about the limits before named. There is, therefore, a very slight deadening of the pulmonary sound below the fourth rib on the right side, below the middle of the sternum, and below the third rib near the sternum on the left; and this deadening increases down to the margin of the lungs, where the sound has the perfect dulness of the solids of the liver and heart. Farther to the left the sound takes more or less of the hollow tympanitic character of the air-filled stomach. It appears, then, that the stroke of percussion reaches to a considerable depth, to organs an inch or more from the walls; and whatever it reaches, may modify the sound. This suggests

* Immediate percussion is now completely given up, and mediate percussion is performed almost exclusively in one way, that is, by using the forefinger of the left hand as the pleximeter, and placing it in complete contact with the chest. The greatest difficulty in percussion however is not the management of the hand which serves as pleximeter, but of that which is the percussor. The finger or fingers which are used for tapping on the pleximeter must be bent at right angles and retained steadily in the same position: the motion of percussion must be performed exclusively at the wrist, and not either at the elbow or shoulder, and the tips of the finger should not be allowed to remain in contact with the pleximeter after they have touched it. In that way the essential requisites for distinct percussion, rapidity, and elasticity of the taps will be obtained. A forcible blow is always to be avoided, it gives pain to the patient and answers no good purpose. G.

to us, that, by varying the force of the stroke, we may make the impulse of percussion reach to different depths, and derive the character of its sound from the superficial, or from the deep-seated organs, as we will. Thus, where the lung overlaps the liver, *strong* percussion will give a shorter deader sound than gentle percussion. Strong percussion receives the character of its stroke from the liver, as well as from the lung; whilst gentle percussion, such as by filiping with the finger and thumb, does not pass through the thin layer of lung, and gives still the pulmonary sound. The same mode of percussion may distinguish the utmost limits of the lungs over the heart. It is more difficult to determine by percussion the precise limits of the lung on the left side; for, in consequence of the loudness of the hollow stomach sound, and the facility with which it may be elicited, it is apt to disguise the pulmonary sound, even with the most gentle percussion. In this case more may be done by observing the amount of expansion of these parts by a full inspiration. The extent of this stomach sound varies according to the state of gaseous distention of the stomach; it not unfrequently reaches, in a slight degree, above the mammilla. There is sometimes a slight dulness on the left side behind, corresponding with the position of the spleen; and in case of enlargement of this organ, the dulness may become extensive.

It must not be forgotten, that the motions of respiration may produce changes in the character and position of some of these sounds. Inspiration, as it enlarges the lung, renders the pulmonary sound clearer, and extends it over every part of the heart, and over a considerable portion of the liver. As the complete and equal enlargement and contraction of the chest, as seen and felt, are signs of the free conditions of the respiratory organs, so the sound on percussion becomes an additional sign of the healthy action, in proportion as the clear pulmonary sound is extended at each expansion of the chest. Percussion is a test, therefore, not only of the statical condition of the lungs, but of their dynamical state also. This point is not enough attended to by auscultators; yet the neglect of it not only would deprive us of additional signs, but would tend to render deceptive the results of statical percussion. For example, in judging of the goodness of sound on percussion, we generally compare the sounds on the two sides of the chest, where in health the structures and sounds are the same; but if we do not attend to the movements of respiration, we may strike one part when the chest is contracted, and the other when it is full, and obtain results which differ from this cause only, and not from any internal change. In practising comparative percussion, therefore, in cases requiring delicacy, it is proper to desire the patient to hold his breath for an instant while the comparison is made; and it is often useful to try the sound when the chest is expanded to the utmost, when it is contracted, and in the intermediate states.

The varieties in the sound of percussion from special diseases will be considered when those diseases are described, but a few examples will be useful here to illustrate the subject. The indurations of the upper lobes of the lung are often small, and so scattered through its substance, that they scarcely affect the sound on percussion; but by a full expiration, they are brought closer together, and if more on one side than on the other, they may then sensibly deaden the sound on that side, especially if gentle percussion be used below the clavicles, and not on a very small surface. Again, the indurations, especially if of some standing, tend to restrain the lung from its full expansion; and if there be a difference on the two sides, it thus may be detected only on a full inspiration. In the disease called emphysema of the lungs, the air-cells are permanently dilated: they contain an unusual quantity of air, which expiration cannot expel: this may be detected by percussion used as a dynamical test; the regions of the heart and middle part of the liver being covered by the permanently distended lung, give, even after expiration, a clear sound. There is one more point to be noticed respecting percussion at the extremes of the respiratory act. Full inspiration makes the sound clearer: full expiration has the contrary effect; but they both raise the note a little; they make its pitch higher. This is in consequence of forcible inspiration or ex-

piration, which are muscular actions, straining the walls of the chest, and thus rendering their vibrations quicker, and therefore the sound higher, as in tightening a drum.

It is unnecessary to add more on the principles of percussion; but it will be useful to give some directions with regard to the practice. In this as in every other art requiring some manual dexterity and the exercise of the senses, practice is necessary to familiarize the beginner with the phenomena and the mode of obtaining them.

In obtaining the sounds of percussion, he soon finds that some dexterity is necessary even in mediate percussion, which is the easiest mode. The fingers or pleximeter should be closely pressed on the walls of the chest: and if the object be comparison between the two sides, they should be placed on corresponding parts, whether between the ribs, along them, or across them. Care should also be taken that the mode of striking be the same, whether it be with one or several fingers, with their tops (in which case the nails should be kept short) or the flat of the last phalanx, or with the knuckles, each of which modes is sometimes preferable. Filling with the middle finger and thumb often gives more uniform and delicate results, especially when the patient is in an inconvenient position, or suffers from tenderness of the walls of the chest. This is also the best mode for abdominal percussion. When striking the clavicle, attention should be paid to what part is struck; for the sternal portion of this bone always sounds much clearer than the humeral end: so also in percussing this or any other part, the direction of the stroke should be perpendicular towards the lungs, and not sideways, or the sound will be modified, not by the lungs, but by the adjacent muscles or other parts towards which the impulse is directed. It is from neglecting this precaution, that beginners sometimes get nothing but dull sounds all over the chest. It is not generally necessary to use much force in percussion: in fact, many of the most valuable results are obtained by gentle mediate percussion; but the mode must be varied in different cases. When it is desired to test the density of a small spot, percussion with a single finger is best: whilst for trying a surface of greater extent, flat percussion with several fingers answer better. In doubtful cases it is proper to try both. In percussing the regions of the back and shoulders, the bony prominences of the scapulæ and ribs should be sought, for these transmit the impulse to the interior far better than the thick layers of muscle. But as the scapulæ are moveable bones, it is necessary to see that they are in corresponding places on both sides; and to ensure this, and to increase the tension of the muscles, it is well in examining these regions to desire the patient to cross his arms in front, and to bend his head forwards. At that part of the chest near the humeral end of the clavicle, a most important region for examination, there is often a falling away of the chest; and the more tense the pectoral muscles are made, the farther they are removed from the walls: here then, instead of making the muscles tense, they must be relaxed, by letting the elbow hang close to the side, whilst mediate percussion is practiced in this region.

The best posture of the patient for percussion is erect or sitting; and in comparing the two sides, both before and behind, the observer should be directly opposite the front or the back. When the patient is lying down, the sound is modified by the matter on which he is lying: if it be a soft feather-bed, the sound is more dull; if a mattress, or any thing hard, the sound will often be increased, because the elasticity of the contents of the chest is increased by the unyielding matter behind it. So also the vicinity of a wall or other hard surface causes a reverberation which gives to the side nearest to it too loud a sound. On the other hand, the vicinity of curtains or other drapery deadens the sound. As most of the effects of percussion are judged by comparison, the chief object of the cautions given is to take care any of the external causes of modification may not act unequally on the different parts of the chest. The patient may sometimes be removed from the influence of these to the middle of the room; and when this cannot be done, these modifying causes must be equalized as much as possible.

Little needs to be said about pleximeters, for they are not generally necessary: M. Piorry much exaggerates the advantages derived from them. A thin circular plate of wood or ivory, with two projections or a raised rim by which it may be held firmly to the chest, is one of the best forms: the surface to be struck should be covered with soft leather, to prevent the clack of the fingers on it. We give the preference to a little oval piece of boxwood, about an inch long, three-quarters of an inch wide, and one-eighth of an inch thick, with a strong handle two inches long rising from its outer margin, at an angle of about forty-five degrees. The handle is convenient for holding it firm to the chest without interfering with the percussing fingers.* The chief precaution necessary in using it, is to take care that it be applied flat and not tilted.

Auscultation of the respiration. Let us now inquire into other modes of producing sounds in the chest, which may prove signs of the condition of the organs within. The contractions and relaxations of the muscles of respiration are in general too gentle to cause sound; but when forcible or sudden, they sometimes produce a sound of tightening, a kind of muscular sound. This is often evident when there is an abrupt catch in the breathing, and during the act of coughing, though it does not furnish any sign of importance. But the internal motions and passage of air to and from the lungs produce sounds; and inasmuch as this passage of air is the great object of respiration, we may expect to find in these sounds signs of the manner in which this object is accomplished. These and most of the other acoustic motions of the chest were first discovered and described by Laennec, who may well be regarded as the father of the art of auscultation. We shall endeavour so to illustrate and extend this art by the aid of physical and physiological science, that we may be enabled to deduce respectively from the phenomena the condition of the organs, and from any known condition of the organs the phenomena which it would produce.

The air enters the lungs by atmospheric pressure, to fill the increased space made in the chest by the action of the muscles of inspiration. On its way to the most expansible parts of the lungs, the fine tubes and cells, it strikes against the sides and angles of the larynx, trachea, and its ramifications, with force sufficient to produce a particular hollow blowing sound. We may hear this on applying the ear to the fore part of the neck, or at the top of the sternum. As the current of air becomes sub-divided and spread in the small bronchi, it loses a part of its velocity, and the sound becomes of a more diffused and less hollow character: it is more like the sighing of a gentle breeze among the leaves of trees; and in passing into the cellular terminations, all of the hollow tubular sound is lost, as may be perceived on applying the ear to most parts of the chest where the lungs lie. This sound seems to depend here chiefly on the impulse of the air against the angles and sides of the minute tubes and cells, but partly also on the opening and stretching of these cells, and perhaps partly on a propagation of the louder sound of the passage of air in the larger tubes. Where inspiration ceases, expiration begins; and a portion of air is pressed out of the cells and small tubes by the collapse of the walls of the chest, and by the contracting properties of the pulmonary tissues. There is a remarkable difference between inspiration and expiration; in inspiration air is the moving body, and rushing through the tubes distends the passive lung: in expiration the lung is the moving body, and by its contraction (backed by external pressure) drives before it the passive air. In either case there is a pressure exerted between the air and the interior of the cells, and doubtless this proves the means of assisting the chemical changes that take place. But it is plain that there must be a difference between the sounds of inspiration and expiration. In inspiration air moving with some velocity meets with the resistance of the angles and sides of the tubes and cells which it has to dilate. Here must be sound in the whole passage of the air, from the nostrils down to the pulmonary cells. In expi-

* A sketch of this form of pleximeter is given in the writer's lectures, published in the *Medical Gazette*.—(AUTHOR.)

ration the motion begins with the lungs; and the air passively yielding to it, there is not motion or resistance enough to produce sound, until by the converging together of the small tubes the impelled air is gathered into a current in the larger tubes, where, impinging against their sides with its now acquired velocity, it at length produces sound. These remarks explain why in natural inspiration there are three kinds of sound produced by the motion of the air through different parts, and hence called *tracheal*, *bronchial*, and *vesicular*. In expiration there are at most only two, bronchial and tracheal. These differences, which were overlooked by Laennec, have been noticed by Andral, Louis, and Dr. Cowan, who ascribe their discovery to the late Dr. Jackson, a young American, who studied at Paris. They deserve attention, and are obviously dependent on the causes which have been mentioned. It is needless, however, to distinguish them in general descriptions, and we shall class them together as the sounds of respiration.

The bronchial respiration varies in intensity on the two sides, and is decidedly more distinct in the right lung than the left, especially at the summit. This arises from the greater diameter and straighter course of the tubes at the summit of the right lung, which are not lengthened and curved as on the left side by the presence of the arch of the aorta. Hence in healthy individuals, especially if they should be thin and their respiration loud, there is a slight difference at the summit of the lungs on the two sides, the left affording a respiration which is almost purely vesicular, and the right, one that is slightly blowing or bronchial. This fact was overlooked by Dr. Jackson in his interesting investigations upon the subject: it first attracted my notice while examining the respiration of children at the hospital at Paris; many who died of acute diseases unconnected with the lungs, offered this difference of respiratory sound during life. Subsequent investigations proved that the same difference existed in adults.

In cases of disease, a given obstruction to the passage of the air produces a much more decided bronchial respiration in the right lung than in the left, and allowance must therefore always be made for the natural inequality. And if the left lung present a slightly blowing respiration, the evidence of disease is more decided than if it should exist on the right side.

G.

The sounds of respiration can be heard on applying the ear to different parts of the chest, being transmitted through the parietes to the parts beneath with sufficient distinctness; and as the healthy sounds vary in these different parts, we may judge of the natural distribution of the tubes, by listening to these sounds. Thus we find in any part of the neck, and at the upper part of the sternum, there is the hollow blowing sound which results from the passage of air to and fro in the trachea, which is therefore called *tracheal* respiration. A little lower down than this, over the space of two or three inches on each side of the top of the sternum, between the scapulæ, and sometimes in the axillæ, there is the sound called *bronchial* respiration, its whiffing or tubular character denoting that it is produced by the passage of air in the bronchial tubes. In most other parts of the chest is heard the *vesicular* respiration; which is a diffused murmur caused by the air penetrating through the minutest tubes, and into their numerous vesicles or cells.

The question naturally occurs, why is the bronchial respiration heard in comparatively few parts of the chest, when bronchial tubes of considerable size are distributed in so many parts of the lungs, within an inch or less of the surface? Why is not the sound a mixture of the tubular and vesicular sounds? The answer and explanation is, that in consequence of its softness and inequality of density, the healthy tissue of the lung is a bad conductor of sound, and does not transmit the sound of bronchial respiration to the surface, except in points where the tubes are large, and approach quite close to the walls of the chest. The flaccid tissue, composed of the different materials, membrane and air, effectually arrests all the slighter sounds produced in the tubes within it. An important corollary from this is, that, as this arrest of the sounds of the interior depends on the light spongy structure of the lung, so any disease increasing the density of

that structure, augments its conducting power, and enables it to transmit the sounds. Hence we find that a great increment of solid or liquid in the lung, as in pneumonia or tuberculous disease, or the compression of its superficial parts by a moderate quantity of liquid in the pleura, as in a recent pleurisy, often not only diminishes the vesicular murmur in consequence of the obstructed state of the cells, but also adds a bronchial or tubular sound of breathing in those parts where naturally the respiration is purely vesicular.

As the several sounds of respiration depend on the resisted motion of the air, so they vary according to the velocity of that motion, and the degree and nature of the resistance to it; they are loud when the air passes in and out forcibly and quickly, and low when it passes gently and slowly. So, on listening to a person's breathing, it may be scarcely audible at its ordinary rate; but if he breathe quick and short, it will be distinct enough. Taking a long breath may not answer the same purpose; for although much air is thus taken in, it may not enter with sufficient rapidity to cause the increased sound. Coughing answers better, for the full inspiration which succeeds coughing is generally quick also; and it is often useful, where the sounds are obscure, to magnify them by this more forcible act. But there is a limit to this power of increasing the sound of respiration by increased effort. If an individual tries to breathe very hard and quick, as after violent exertion, the movements of the lungs cannot keep pace with those of the external muscles of respiration, and the air does not freely enter, the sound will be diminished or altered rather than increased.

As we can vary the sound of respiration by varying the act in the same individual, so we find that a difference exists naturally in different individuals; in some, as in many robust adults, the ordinary respiratory sound is very low and faint; in others as in children, in nervous females, and in slight irritable persons, it is loud and distinct. In the last mentioned cases, the respiratory movements are more brisk; and although air may not be taken in more frequently or in such great quantity as in other cases, yet it enters more suddenly, and meets with greater resistance in its passage, so that it must cause more sound. As this loud respiration is commonly met with in children, Laennec called it *puerile* respiration. So, also, by rendering the respiration quicker and more energetic, it may be made to sound loud in those cases in which it is naturally faint, as by the quick short breathing just mentioned, or, better still, by desiring the person to hold his breath for awhile; the quick strong inspiration which follows, is noisy enough. Disease sometimes brings about this same change; thus, if a considerable portion of the lungs be obstructed, the force of the act of breathing will be concentrated on the remaining portions, and the air will be carried in and out of them with unusual energy and noise. Hence Andral terms this partially increased respiration *supplementary*. So also, under some circumstances, without any obstruction, the want of breath may be increased, as it happens during moderate exercise, in some degree during digestion, and on exposure to cold; here the whole respiration is more energetic and its sound louder. Farther, as the act of breathing depends on a particular impression of the nervous system, so it may be supposed, when this system is preternaturally sensitive, the ordinary impression produces an increased effect; here, again, the respiration becomes more energetic and noisy. This appears to be the chief cause of the increased sound of respiration in fevers and other diseases where the nervous sensibility is exalted. Lastly, it is possible, by an external restraint of some parts of the chest, to render the sound of respiration louder in other parts. Thus, by enclosing the abdomen and lower part of the chest in a tight belt (and the experiment is already prepared in the persons of tight-laced females,) the sound of respiration is made unusually loud in the upper parts; and it may be seen by the heaving of these parts how their motions are augmented. Acute pain or tenderness of some of the parts moved in respiration would have somewhat of the same effect as a ligature, for it would cause an instinctive restraint of those parts which would throw on others supplementary labour.

It appears, then, that there may be much variety in the sound of respiration without disease of the lungs; and except in the case last mentioned, it is where there is a comparative discrepancy in the several parts of the lungs rather than any absolute difference, that disease of these organs is indicated. Thus, if we find the respiration loud on one side and obscure on the other, or clear in the lower part of the chest, indistinct in the upper, we may well suspect some obstruction to exist in those parts where the sound is obscure; and the nature of that obstruction is then to be tested by percussion and other means.

There is another kind of variation in the respiratory sound that has not been attended to—that which affects its duration. In this, as in other varieties, there are absolute differences in different individuals, and in the same individual under different circumstances; but we shall only notice the comparative discrepancies in the same subject and at the same time, which alone constitute signs of disease. We may hear the sound of inspiration on one side distinct and prolonged during the whole inspiratory act, whilst on the other side it is loud enough at first, but is abruptly arrested before the act is complete, and it is stopped with a sort of hitch. Hepatisation or compression of the lower portions of the lungs will do this; so will a moveable plug of tough mucus in the bronchial tubes. In other cases, again, we find the circumstances reversed: there is in a part of the lung no sound during the first part of inspiration; but towards its end, when the chest is most expanded, there is a short wheeze. This happens where the bronchial tubes are so far obstructed that air will not pass through them, until they are distended by a full inspiration, as in bronchitis. It appears also in extensive pleuritic effusions which distend the parietes of the chest beyond the medium state of respiration; it is only the *acmé* of inspiration that can then introduce air into the compressed lung, and it is at this period alone that the respiratory sound is heard.

There are other morbid varieties of respiration, such as *cavernous* respiration, caused by the passage of air in and out of an unnatural hollow or cavity in the lung; and where this cavity is very large, the sound becomes *amphoric*, like that of blowing into a phial. These and other varieties will be noticed when we treat of the diseases which produce them; and are included in the tabular view of the sounds given farther on.

Rhonchi. We have hitherto considered the sounds produced by the passage of the air to and fro in the lungs, and we found that the varieties of these sounds depend on the size of the tubes, and on the force with which the air strikes against their sides and angles, and that they may be shortened or stopped by various kinds of obstruction. We have now to describe a class of novel sounds which arise from partial obstructions to the passage of the air; obstructions which permit the air to pass, but not without such a resistance as causes an increased and modified sound. Thus, if a bronchial tube be narrowed by the swelling of its membrane, or by mucus secreted by it, the air will pass through the narrowed portion with increased velocity and increased resistance; and hence the sound is changed from a simple breathing or blowing to a louder wheezing, bubbling, whistling or snoring, according to the nature of the obstruction. These new sounds Laennec called *râles* or *rattles*. We prefer the Latin term *rhonchus* (which is from the Greek *ρῶχος*,) as more expressive; and it has been adopted by most English writers. If there were one, it would be desirable to use an English word, for nothing injures the purity of a language more than the introduction of foreign words.

The rhonchi may be divided into the *dry* and the *humid*, according as the impediments that produce them are solid or liquid.

Of the *dry* rhonchi there is the sibilant or whistling rhonchus, which is sufficiently described by its name, and may generally be imitated by whistling between the teeth. It is produced by the passage of air through a small and somewhat circular aperture; and this aperture may be formed by a slight obstruction of a small tube, or by a greater obstruction in tubes of larger size. It generally oc-

curs in tubes narrowed by swelling of their mucous and sub-mucous coats, such as occurs in the early stage of acute bronchitis; but it is heard also in asthma, where the tubes are congested and constricted by the spasmodic contraction of their circular fibres; and it may happen, also, when viscid mucus clings to and diminishes the caliber of the tubes.

The sonorous rhonchus is a snoring, humming or droning sound, and may vary in loudness or key, from an acute note, like that of a gnat, down to the grave tone of a violoncello or bassoon. It must be produced by an obstruction leaving a flattened aperture, the lips of which, or the moisture on them, yield to the passing air with a vibrating resistance. Partial swelling of the sides of a tube, particularly at its bifurcation, a pellet of tough mucus in it, or external pressure on it, may cause such a flattened opening within the tube; and the sound in question, therefore, occurs in various forms of bronchitis, and often accompanies tumours which press on the bronchial tubes. When caused by tough phlegm, coughing generally changes or removes it; when from the other causes, it is generally more permanent. When quite permanent, it usually depends on the pressure of a tumour, or some deposit outside the tube. The key or note depends chiefly on the size of the aperture left: when this is small, the note is high; when large, it is more of a bass: from this may be inferred, that the latter can have its seat only in the large tubes; but as a more considerable obstruction may flatten their caliber to the smallest size, these may also be the seat of the acute notes. Almost every variety of this rhonchus may be imitated by blowing between the lips moistened with saliva, and almost closed.

There is another rhonchus, which may be called the dry mucous, because it is produced by a pellet of tough mucus obstructing a tube, and yielding to the air only in successive jerks, which cause a ticking sound like that of a click-wheel. When the air is driven very fast, these click-sounds pass into a continuous note, and constitute the sonorous rhonchus. Sometimes, again, particularly in inspiration, the click-sound suddenly stops, the tough mucus being forced into a smaller tube, which it completely closes, and may not be dislodged again, but by dint of forcible coughing.

Now, as any of these rhonchi may be produced in only one tube and yet be very loud, it is not to be supposed that they are important in proportion to the noise they make. It is rather when they are permanent, or when several of them are heard at once in different parts of the lungs, that they bespeak disorder that may be serious, either from its continuance or from its extent.

The *humid rhonchi* depend on the passage of air in bubbles through a liquid in the lungs, and their varieties are produced by differences in the size of the tubes, and in the nature and quantity of the liquid, which cause varieties in the bubbling sound. A bubble is a portion of air contained and slightly compressed, by a thin film of liquid, which preserves its integrity by its molecular or aggregative attraction; when this attraction is overcome by the gravitation of the liquid, the motion of the air, or any other disturbing cause, the bubble bursts; as it bursts, the air from it, slightly expanding, gives to the adjacent air, an impulse which, if forcible enough, produces sound. In the bubbling passage of air through a liquid, the air is the moving body, the liquid gives the resistance; and in proportion as these are strongly and suddenly opposed to each other, the louder will be the sound produced. If the air pass with force, it makes most noise in a liquid of some tenacity, which offers it most resistance; but if it move slowly, such tenacity may retard the breaking of the bubbles, and therefore diminishes the sound. Again, air passing through a liquid in large tubes, gives most sound when the liquid is thin, because the bubbles form and burst quickly; but in passing through very small tubes, air causes more sound with a rather viscid liquid, which, adhering to the tubes, is not carried before the air so readily as one of a thinner nature. This rule is applicable to bubbling sounds or rhonchi heard in the chest.

The *mucous rhonchus* may be heard in large and smaller bronchi down to the
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size of a crow's quill; and in these tubes its gurgling or crackling presents different degrees of coarseness. It is an irregular and varying sound, composed of unequal bubbles, and often interspersed with some whistling, chirping, or hissing notes. Its most common cause is acute bronchitis, which after its onset, is attended with a secretion of liquid mucus into the bronchial tubes; and the passing of the sibilant and sonorous rhonchi of the first or dry stage into the bubbling of the second or secreting stage, is often marked by a curious combination of chirping and cooing notes, like those of birds in a bush. When the bronchial tubes become enlarged by disease, or when morbid cavities are formed by the destructions of portions of the lung, the bubbling of air through liquid in these is of the coarsest kind; it is quite gurgling, and, if the liquid be scanty, has a hollow character, and is called cavernous rhonchus.

When there is a little liquid in the smaller bronchi, the bubbling or crackling is more regular, although the sound is weak, and is sometimes only a roughness added to the ordinary respiratory murmur. This is the *sub-mucous* rhonchus. It may result from slight degrees of bronchitis, and owes its importance only to its being permanently present when such slight inflammation is constantly kept up by the irritation of adjacent tubercles in an incipient state.

When there is more liquid, not viscid, in the smallest tubes and terminal cells, the rhoncus has a still more crepitating character, and resembles that heard on applying the ear near the surface of a liquid slightly effervescing, such as champagne or bottled cider. This is the *sub-crepitant* rhonchus, which is heard in œdema of the lungs, humid bronchitis, and other affections in which liquid and air occupy the extreme tubes, and are forced through each other in the motions of breathing.

But the most perfect and equal crackling is that of peripneumony, and is therefore called the *crepitant* rhoncus; it exactly resembles the sound produced by rubbing slowly and firmly between the finger and thumb a lock of one's hair near the ear. We believe that this sound depends on the forcible passage of air through a little viscid mucus in the finest tubes, narrowed by congestion and deposite around them, but we shall have occasion to investigate this subject under the head of PNEUMONIA.

Of all these different rhonchi, we may repeat what we said of the morbid sounds of respiration, that they may occupy the whole of the respiratory movements, or be confined to part of them. Thus, an obstruction which is sufficient, at the commencement of inspiration, to cause a rhoncus, may be insufficient when the tubes are dilated by the distention of a full breath, or there may be the converse; an obstruction which is total in low degrees of respiration and stops all sound, in forced or extensive efforts, as in coughing, occasions a rhonchus. This suggests to us the propriety of using these different degrees of respiration to test the nature and extent of bronchial obstructions. It may also be inferred from what has been said, that the different stages and degrees of force in respiration may change the note of the different rhonchi, and thus produce such a variety as that which we hear in the chests of some catarrhal and asthmatic patients. Laennec used to call this combination of piping sounds rhonchus *canorus*. It may be readily conceived, too, that these several rhonchi may be variously combined, or exist at the same time in different parts of the lung, and give rise to numerous combinations which it is needless to dwell on. It has been stated that the loudness of a sonorous or sibilant rhonchus is no proof of the severity of the disease; nor is the fact of its being audible over the whole chest, unless the respiratory murmur be at the same time absent or very feeble in parts. But the presence of the bubbling or crepitant rhonchi does imply mischief proportioned to its extent; and if they are heard over a large space, and accompanying the whole act of respiration, diminishing or destroying the natural murmur, they denote disease of a very serious character, because, as our hearing informs us, there is an obstructing liquid in the tubes where there ought to be only air, and the function of respiration must be injured in proportion.

Auscultation of the voice. We now proceed to examine another class of sounds—those of the *voice* as transmitted through the chest. We have found that the sounds of respiration, which are chiefly produced by air passing in the lungs, are transmitted to the air on the surface of the chest. In like manner the sounds of the voice, which are strongly communicated to the same air, are transmitted modified by the size of the tubes, and the nature of the substance through which they pass; and thus these sounds also become signs of the condition of the organs that transmit them.

On applying the ear to the throat or upper part of the sternum of an individual whilst he is speaking, the voice is heard so loud that it seems as if he were speaking into the ear, only the articulation is not so distinct. The reason of this is obvious: the sound of the voice, although originating in the vibration of the glottis, is propagated to the air above and below it; that below, being pent up, is not heard without bringing the ear into contact with the parts where the tubes run, and it there resounds with all its force. This is called *tracheophony*, or the natural tracheal voice.

But when the trachea divides and sub-divides there is not only a division of the sound into smaller tubes, and a consequent diffusion of it and reduction of its strength, but at this division the tubes plunge into the spongy tissue of the lung, which, as we have before found, is a bad conductor, and tends to stop the sound. Hence over the chief bronchial ramifications, on each side of the upper part of the sternum, at and between the scapulæ and in the axillæ, the voice is still heard, but more diffused and distant than at the throat and sternum, and the articulation is still less distinct. This is natural *bronchophony*, or bronchial resonance.

In other parts of the chest, as the voice gets into the finer tubes with their more flaccid coats and minute cells, its vibrations are either choked and destroyed, or in some parts they may be transmitted across the tissue to the parietes in merely an obscure diffused fremitus. This may be called the *pectoral fremitus*, or *vibration*. It may also be felt by the hand applied to the chest. Before describing the modifications of these sounds by disease, we must notice some natural varieties and their physical causes.

Natural bronchophony, or the vocal resonance in the bronchial tubes, is most distinct in thin persons with a high or treble voice, as, in females and children: shrill or treble notes penetrate farther into the small tubes, because their vibrations are less extensive, and need less room than those of deeper tone. This may be understood on observing the different vibrations of the cords of a musical instrument: the motions of the treble cords are short and quick, so as to be scarcely visible, whilst those of the bass are long and quite distinct. So in a person with a bass voice, the sound will hardly pass into the sub-divisions of the tubes, and there will be little or no bronchophony: but if the voice be strong, it will not be entirely lost, for it will pass across the whole spongy tissue, and throw it all, more or less, into a diffused vibration, which may be heard and felt in many parts of the chest in the character of pectoral fremitus. We find, then, that treble tones give more of bronchophony, and bass ones more of the pectoral fremitus. The same occurs with the morbid sounds; and if we can get our patients sometimes to change their tone of voice, we may thereby more effectually test the condition of their pectoral organs.

Now, as with corresponding varieties of respiratory sound, so with these sounds of the voice, they become signs of disease when they are heard out of their proper places. To know what these proper places generally are, it is necessary to study the anatomical disposition of the tubes, and tissue of the lungs in the different regions. But there is another standard more applicable to individuals, viz., comparison between the two sides of the chest. As there is an approach to symmetry in the structure of the two sides, so there is, in health, a general correspondence between their sounds; and as disease scarcely ever affects both sides at the same time in the same degree, it will make the phenomena of

one side to differ from those of the other. For example, if under one clavicle the voice resound loudly, whilst it is scarcely heard under the other, it is certain that there is some physical difference between the two sides that does not exist naturally; or if below the third rib in front there be heard the tubular or bronchial voice which is generally confined to the immediate neighbourhood of the large bronchi, it may be inferred that there is an altered condition of the parts. Let us inquire what alterations will change the natural disposition of the sounds.

An increase in the density of the pulmonary tissue by a solid or liquid effusion, or even extensive sanguineous congestion in it, will improve its conducting power, and enable it to transmit from the bronchial tubes the vocal sounds which they receive from the trachea. This is *morbid* bronchophony, and it is usually accompanied with bronchial respiration. If, then, the voice be heard resounding in a part of the chest where it is not usually heard, it may be suspected that the lung is in some way increased in density; but this is not certain until it be tested by farther means, for there is another change which may also increase the vocal resonance of a part. If, instead of the sound being better conducted from within, it is increased in strength and extent by an enlargement of the bronchial tubes, it may then be heard in situations where it does not naturally reach the walls of the chest. In both cases it may more or less resemble the natural bronchophony heard near the top of the sternum, and between the scapulæ; but it often presents considerable modifications. Thus, when transmitted from the middle-sized bronchi, it comes rather as *diminutived bits of voice* than as articulate words; and for reasons before mentioned, low tones are not transmitted; so that if the patient varies his cadence, some words are heard and others not. When arising from dilated air-tubes, or when transmitted from the larger tubes, the resonant is more noisy and continued, varying less with the tone of the voice. If the air-cells over the resonant tubes be still open, the sound will be diminished when they are dilated by a full inspiration, because they then tend to intercept it more. The loudest bronchophony is caused where the middle and upper lobes of the lung are pressed against some part of the walls of the chest by a liquid effusion in the pleura, which cannot displace the lung from that part, because it is bound to it by old adhesions.

But what modifies the transmitted voice in the most remarkable manner, is a thin layer of liquid between the lung and the walls of the chest. The liquid is thrown by the vocal resonance of the lung into a state of irregular vibration, which causes it to transmit the voice in a broken tremulous manner, so that it sounds to the ear outside like the bleating of the goat. Hence Laennec called it *ægophony* (αἴγος φωνή.) It may be produced simply by liquid in the pleural sac, without disease of the lung; for the compression of the pulmonary tissue caused by the liquid is enough to enable the lung to transmit the voice from the bronchial tubes within it. When the lung is consolidated also by disease, the vocal resonance is stronger, and there is a loud bronchophony mixed with the bleating voice, constituting a kind of double or buzzing voice, which Laennec compared to that performed in the exhibition of *Punch*.

There is yet another kind, which may be called the perfection of vocal resonance in the chest. When a cavity is formed in the lung by the emptying of a vomica or abscess through the air-tubes, the voice passes from these tubes into it; and if the communication be free, the voice may, by the ear applied outside, be heard in the cavity as distinct as it is in the trachea. This is *pectoriloquy*—not only voice, but speaking in the chest. When the cavity is near the surface, of moderate size, and opens freely into a large air-tube, the phenomenon is most perfect, and then sounds exactly as if a patient spoke into the ear: this is limited to the spot where the cavity lies, which is thus, as it were, a little island of voice, and is a sure sign of a cavity. The sound of bronchophony is often louder, but then it is more diffused, and there is less distinctness in the words. We shall enter farther into these distinctions when we treat of the lesions of which they are signs.

When the cavity is large, and the opening into it small, the voice may not fully

enter it; but there may be a tinkling or hollow reverberation in it, like that in a phial. This is an echo modified by repeated reflection, and constituting a separate note. It is called *amphoric resonance*, or *metallic tinkling*, according to the character of the sound. It may be produced in the cavity left by a large vomica or abscess, or by several of these running together; but its more common seat is the sac of the pleura, into which the air has entered through a fistulous opening from the lung. This being the resonant or echoing cavity, it is plain that not the voice only, but the breathing and cough also, especially if they be accompanied by a bubbling through the fistula, will have more or less of this tinkling or bottle sound.

Besides these various positive phenomena of the voice, the absence of the *vocal fremitus* is sometimes a valuable sign. It has been stated that this pectoral fremitus can be felt as well as heard. On applying the hands, one on each side of a healthy chest, the vibrations may be felt nearly alike on both sides. Liquid in the pleura will generally more or less destroy this fremitus; and the difference which it produces between the two sides is often a very valuable sign of the presence of liquid. Consolidation of the lung, again, will increase the vibrations, or make them even stronger over the bronchial tubes. In cases where one side is quite dull on percussion, we may often thus easily distinguish whether the dullness is caused by a consolidated lung or liquid in the pleura, which is a point of great importance.

Besides the sounds produced by air and the voice, there is sometimes one produced by the motion of the lung against the ribs. The lungs, although they nearly follow the motions of the chest, do not move quite with it, especially in the lower parts, where the descent of the diaphragm draws the lungs downwards whilst the ribs are rising. But in the natural condition the surfaces of the pulmonary and costal pleura are so smooth, and so well lubricated with serum, that although there is motion, there is not resistance enough to that motion to cause sound. But if these surfaces become uneven by the deposit of rough matter on them, or by an irregular distention of the tissue by solids or air under them, there may then be a rubbing sound with the motions of respiration; this occurs in pleurisy and emphysema of the lung. This rubbing sound is often the more evident in these cases, because the same disease, by preventing the proper expansion of the lung, causes less harmony than usual between its motions and those of the chest.

The foregoing description of the acoustic phenomena of the chest connected with respiration may perhaps be considered rather minute, and it is hardly expected that the student will be able easily to master all the details; but if sufficient attention be paid to the principles that have been explained, the various phenomena which are illustrations of these principles will become familiar and intelligible when they present themselves in clinical experience. In the descriptions of individual diseases we shall again meet with these phenomena; and by the principles which have now been explained, we shall be prepared for them wherever they may occur. The subjoined tabular view of the chief phenomena of auscultation of the organs of respiration, may give additional assistance.

SOUNDS PRODUCED BY THE PASSAGE OF AIR IN RESPIRATION.

SOUND OF RESPIRATION.—*Natural*; produced by collision of the air against the sides and angles of the air tubes.

Tracheal; heard in the neck and at the top of the sternum.

Bronchial; near the upper parts of the sternum, between the scapulae, &c.

Vesicular; in most other parts of the chest.

Morbid, modified in production or transmission.

Bronchial, or whiffing; transmitted from the bronchi by condensed tissue of the lung.

Cavernous } produced in morbid cavities communicating with the
Amphoric { bronchi.

and in children where the stethoscope might cause alarm, and could not be so steadily or quickly applied.

In practice the chief advantages of immediate auscultation are the great facility and quickness of its application. The whole chest can be explored with nearly the same accuracy and with much greater quickness than if the stethoscope be used: and in no case is there any objection to the direct application of the ear to the posterior parts of the thorax; the simple expedient of throwing a thin towel, or muslin cloth, over the shoulders of the patients, removes the observer from direct contact with the body of an uncleanly patient; which constitutes the only objection to this method of auscultation. For this reason those who are really familiar with auscultation, and use it as an ordinary every-day means of exploration, almost always prefer the immediate application of the ear.

There are, however, many decided advantages in using the stethoscope for the examination of the anterior parts of the chest. A better idea may be obtained of the sound and impulse of the heart, and the hollows about the clavicles may be all examined more accurately, and the exploration of the chest of women is freed from the objections which are obvious enough in direct auscultation. G.

We want an instrument, then, to transfer the sounds from the chest to our ear, which must be a good conductor of sound; and as the power of bodies to conduct sound depends on the strength and uniformity of their elasticity, and their capacity to vibrate like the body that produces the sound, we must have an elastic material, of density resembling that of the sources of sound within the chest, and of the walls of the chest through which they are transmitted. But the sources of the pectoral sounds vary: some, as the voice and respiration, or at least the hollower sounds of respiration, are produced in air; whilst in others, such as the sonorous rhonchus, the rubbing sound, and the sounds of the heart, the solids are chiefly concerned: we shall, therefore, need a varied capacity in our instrument to receive these sounds. It should be a uniform solid, and the lighter it is the better, provided it be thoroughly rigid. Now nothing answers to this description so well as wood; and in the light kinds of wood with a stiff longitudinal fibre, such as pine-wood, deal, cedar, and the like, we find these qualities in perfection: through a cylinder of such wood, about eight inches long, and an inch and a half in diameter, adapted to the ear at one end, most of the pectoral sounds may be heard: but those best which originate in solids, such as the sounds of the heart, of friction and sonorous rhonchi. The sounds of respiration and of the voice are also heard through it, but not nearly so distinctly as with the naked ear.

We need, therefore, an aerial conductor for these sounds, because they originate in air, and can best be transferred through air. By perforating the cylinder with a bore a quarter of an inch in diameter, it becomes a tube through the column of air in which the respiration and voice may be heard with increased distinctness. But as this column of air is in contact with only a small spot of the chest, it can transmit only the sounds produced under or very near that spot, and the instrument thus prepared is well-adapted for the exploration of small parts of the chest. But we want the instrument also to transfer the sounds of larger spaces: the sounds of so limited a space are often too weak to be heard alone; and besides, it would be very tedious to go over the whole chest, *dotting* in this way a quarter of an inch at a time. Now, if the column of air be enlarged at the base where it is in contact with the chest, by hollowing out the wooden cylinder into a funnel shape, it will conduct the sounds produced on this greater extent of surface, which are reflected by the funnel into this central bore, and conveyed concentrated to the ear. This also gives the instrument the power of concentrating or magnifying the sounds; they are thus heard as strong at the distance of several inches or even a foot or two from the chest as they are to the

ear in close contact with it; nay, in some cases they are even stronger. The best shape for the excavated end is that of a long funnel or cone, with its apex terminating in the central bore; for this directs the sound at once in the right direction without repeated reflections, which may modify it. As we still sometimes want to explore small spots of the chest, by means of a perforated plug the excavated end can be filled and the instrument reconverted into a simply perforated cylinder. To make the instrument more portable, the upper part of the cylinder may be reduced to a stem half an inch or less in diameter, leaving only at the top a sufficient width for the ear; or this top may be made of a harder wood, or of ivory. Wood is so excellent a conductor of sound, that when once the vibrations are in it, they can be conveyed by a very small body of fibres.*

Thus the stethoscope, although a simple instrument, performs several offices in relation to sound, the chief of which may be enumerated as follows: 1. To conduct sound by its solid walls. 2. To conduct and concentrate sound by its closed column of air. 3. To transfer sounds from its column of air to its solid walls, or the converse, when circumstances impede their transmission by one of these ways. 4. To diminish this power of transfer, and contract the field of hearing when small spots are to be explored.

We have now only to add a few words on the method of using the stethoscope. It is quite necessary that the instrument should be applied in close contact with the chest and the ear; the least tilting uncloses the column of air, and occasions great loss of sound outwardly as well as a confusing entrance of extraneous noises. To prevent this tilting, it is best to hold the stethoscope by its pectoral end firm on its base, and then to apply the ear flat on the top. If the inequalities of the ribs leave chinks between the chest and the instrument, a fold or two of linen will fill these, or the stethoscope may be used with the stopper in. For the sounds generally, it is better to use the instrument without the stopper; but when it is an object to determine, whether a sound is produced in a limited space, or over some extent of surface, the circumscribing power of the stopper is wanted. Thus it is often of importance to determine whether a local resonance is produced in a small cavity, or merely transmitted by consolidated lung from several bronchial tubes distributed over some extent of surface. The simply perforated cylinder will often do this by showing the size and shape of the limited spot in which the resonance or pectoriloquy of a cavity can be heard in its full strength, while the bronchophonic resonance is transmitted less strongly and may be traced over some extent of surface, generally in the known direction of these tubes. The stopper is also useful in shutting out the sound of respiration, when it is an object to listen to the sounds of the heart or arteries, and in many other circumstances which will be noticed in the history of special diseases.

In conducting physical examination, due care should be taken to avoid fatigue or annoyance to the patient. There are cases in which a complete physical examination will do more harm than the information which it may bring can do good; but they are few, and it must be left to the discretion of the practitioner to hold the balance between too much and too little examination. Experience soon points out that the observer must also consult his own ease in the act of auscultation; for a constrained or painful posture impedes the hearing and disturbs the atten-

* A flexible stethoscope is extremely convenient for the examination of the heart, and will answer well for the lungs, it does not conduct the impulsion of the heart while the sounds are perfectly conveyed through the tube. This instrument, which is nothing but an acoustic tube fitted with a proper end piece—answers admirably in the examination of the heart of animals and was used for that purpose by Dr. Pennock, of this city, in his interesting experiments. All stethoscopes limit the spot from which the sounds arise, but diminish their intensity; these advantages and disadvantages both belong to the flexible as well as the common instrument.

tion. For this reason, it is sometimes easier to hear with a flexible ear-tube than with the straight stethoscope, although the latter is by far the best instrument for general purposes.

II. EXAMINATION OF THE CHEST THROUGH THE VITAL PROPERTIES OR FUNCTIONS OF ITS ORGANS.—ANALYSIS OF THE GENERAL SYMPTOMS OF DISEASES OF THE CHEST.

We have been hitherto occupied in considering the *physical* properties of the chest and its organs, and the manner in which these properties may become signs of the condition of these parts. We have now to examine them through their *vital* properties, which, combined with certain physical and chemical powers, constitute *function*. Physiology teaches us that the elementary vital properties immediately concerned in the function of respiration, are sensibility and contractility, to which may be added, the power of secretion. These properties are closely linked together with the chemistry and mechanism of the organs of respiration, so as to constitute their healthy function. Any excess, defect, or disorder, of any of these properties, will be more or less felt throughout the links of this chain, and hence may arise not only derangement of the function of respiration, or *dyspnœa*, but also new phenomena proceeding from a loss of due balance of the properties, such as *cough*, *expectoration*, and *pain*; and linked as the vital properties are with those of other organs, there may be added disorders of these in the form of disturbance of the circulation, and its sign the arterial pulse, general fever, disorder of the secretions of the kidneys, liver, and intestines, and of the digestive, nutritive, and sensorial functions. The phenomena arising from these several disordered properties are what are called the *vital* or *general symptoms* of disease, which we now have to consider in relation to the organs of respiration.

It may be inferred, and will be more apparent as we proceed, that these general symptoms, dependent as they are on such a linking together of many properties, the laws of which are but imperfectly understood, must be far less simple and intelligible than the physical signs; and the variable measure of the vital properties also renders general symptoms far more uncertain than these signs, in their degree, and even in their presence. We cannot with any certainty, as with the physical signs, from a knowledge of the phenomena, and the laws which regulate those phenomena, deduce the condition of the parts which produced them, nor, from knowing the condition of parts and physical laws, deduce what phenomena the parts ought to develop. For example, the solids of the body have sensibility, which varies not only in different parts, but in the same parts at different times, and this for reasons which we cannot discover; therefore we cannot calculate on it. The contractility of moving parts also varies in a similar manner; and we can by no means gain, from the character of their motions, a criterion of their true condition. Instead, therefore, of pursuing the synthetic as well as the analytic method, which we have done with regard to the *physical* examination of the chest, we shall shortly analyze the chief *general symptoms* of diseases of the chest, and by that examination endeavour to determine their nature and varieties, and their value in teaching us to discover, to measure, and to treat these diseases.

Dyspnœa, difficult or disordered breathing, is the most important general symptom of disease of the chest, inasmuch as it implies some interruption to the due performance of some part of the great function of the chest—respiration. Dyspnœa may be caused by circumstances affecting any one or more of the several elements concerned in the function of respiration, viz. the blood in the lungs, the air, the machinery of respiration by which these are brought together, and the nervous system through which the impression which prompts the respiratory act is conveyed from the lungs to the medulla oblongata, and thence to the muscles which move the machinery; in fact, all the causes which in excess produce asphyxia, in slighter degrees occasion dyspnœa. Subjoined is a table which exem-

plifies these causes of dyspnœa; but the character of the symptom itself must first be described.

When any thing interferes with the sufficient action of the air on the blood, the impression which prompts the acts of breathing not being relieved, causes a quicker and fuller repetition of this act, and if the interference still remain, the breathing will continue to be more or less hurried and forced, until the sensation or impression is reduced to the ordinary standard of almost unconsciousness. An individual in whom the breathing is hurried may not be sensible that it is accelerated; whilst in another who feels the oppression, there may be little appearance of shortness of breath. Again, the feeling of dyspnœa must greatly depend on the condition of the sensorium; for whilst some patients are conscious of the slightest infringement on their respiration, others, particularly in congestive fevers, are brought to the verge of asphyxia without complaining of any oppression. So, too, we are sometimes astonished to find, on opening the bodies of the dead, a whole lung diseased, or one side of the chest full of serum, where the patient had not complained at all of dyspnœa; while, in other cases, a much smaller lesion of the organs has been attended with the most distressing orthopnœa. It is, however, rather to the sensation of breathlessness than to merely accelerated breathing, that the word dyspnœa is generally attached, for, translating it as difficult breathing, this expression can be hardly applied when the difficulty is overcome by accelerated movements of which the patient may not be conscious. But we shall here advert to frequency of breathing, as well as the feeling of dyspnœa.

The number of respirations in a healthy adult male at rest, generally ranges about twenty in a minute. It is more in children and in females, and it becomes increased in all cases, not merely from affections of the lungs or connected organs, but also from general weakness or depressing causes, which, diminishing the strength of the muscles of respiration, oblige them to make up by the frequency of their contractions what is wanting in their energy. Probably there are some nervous conditions of the system also, in which the breathing becomes accelerated, from what Cullen called *mobility*, a greater readiness to move than power to complete the motions. We have seen the breathing hurried in some cases of hysteria, without the patient being conscious of it, and without either real weakness or pectoral disease to account for it. These cases are of no consequence in themselves, but should be known, that they may be separated from those of true dyspnœa. In many other cases, especially those, we believe, where the nervous system is affected, the breathing is not accelerated, but suspirious, a sigh or deep breath being taken from time to time; yet the patient is often not conscious of any oppression or unusual effort. This may be called irregular breathing, and there are several other varieties, which we have not time to consider in detail. The rhythm in breathing probably depends entirely on the chain of influences which we before described as concerned in the act, and not on any peculiar periodicity, such as that which seems to reside in the heart; and therefore irregular breathing must depend on a change in one or more of the links in that chain.

The feeling of dyspnœa is one of a very peculiar and distressing character. Even when slight in degree, its permanent oppressive influence is very wearing; and when severe, it causes the most indescribable suffering, with such a feeling of impending death, that the most courageous are often unmanned by it. The constrained postures of the patient, the anxious or even desperate expression of his countenance, the painful straining of all the muscles that can in any way, however distantly, assist in the respiratory movements, bespeak the intensity of the feeling, which is far worse than the most acute pain. It is worthy of remark, however, that this feeling is experienced in its severest degrees only by those in whom the dyspnœa comes on rather suddenly, especially when the sensibility is entire, and the lungs are not diseased, as in obstructions in the trachea or large bronchi, spasm or swelling of the glottis, and spasmodic asthma. In these cases the sensibility is not gradually blunted by the circulation of imperfectly oxygenated blood; nor has the activity of the functions, which require arterial blood, been lowered by previous

depressing causes. Opium, belladonna, camphor, and other narcotics, will sometimes relieve the symptoms of dyspnœa not only by deadening the sensibility, but also by diminishing the activity of those functions and secretions which require oxygenated blood, and therefore a free supply of air. If we could temporarily produce a state approaching to the torpor of hibernating animals, we might diminish the bad effects, as well as the painful feeling of dyspnœa; and we believe that such a state is actually induced in those who are habitually asthmatic, in whom all the functions are brought to a lower standard, and who thus suffer with impunity such an encroachment on the function of respiration as would be fatal to an individual of a common standard.

The feeling of want of breath has been used as a means of testing the condition of the respiratory organs. A person whose respiration is free and unembarrassed, can hold his breath longer than one whose lungs are diseased. Dr. Lyons has proposed to measure the condition of the lungs by the time which he can *hold the breath*, after a full inspiration; and to ensure accuracy, the patient is desired to count numbers during this time. A healthy person with a good chest can continue counting for forty-five seconds without taking breath, whilst those with diseased lungs often cannot keep on for twenty seconds. The same objection may be made to this test that we made to the measuring of the exhaled air proposed by Mr. Abernethy, that it is a test as much for the strength of the muscles of respiration as for the condition of the lungs. Besides, both the feeling of want of breath, and the power of augmenting the respiratory movements, vary considerably in different healthy subjects. It is well known that divers acquire the power of remaining under water for two or three minutes (it has been said more) without taking breath. In diving animals there is a structural provision to enable them to continue some time without air. The chief venous trunks are very tortuous, and admit of dilatation, so that the venous blood can accumulate in them, instead of distending and embarrassing the right cavities of the heart and the lungs. Perhaps some change of this kind may be somewhat produced in divers by the often repeated practice of holding the breath. Professor Faraday has described another mode by which a person may be enabled to hold his breath for a minute and a half, which is double the time usually practicable. This is by making in succession five or six full and forcible inspirations, which seem to so completely change the air in the lungs, that there is left in them a stock of pure air capable of lasting during that time. The knowledge of this fact may be useful, if ever it is wanted to hold one's breath for a time in going into the suffocating atmosphere of a sewer, a mine, a house on fire, or the like, or in diving.

Dyspnœa is often a symptom demanding great attention in diseases of the lungs; but it must be studied in conjunction with the other general symptoms and the physical signs, for in itself it is most vague and inconclusive. This may be perceived on inspecting the subjoined tabular view of the causes of dyspnœa, which is founded on the physiology of respiration. This table deserves attention, not only in showing the varied nature and origin of the symptom, but also in contrast with the tables of the physical signs, the causes of which are much less varied, and far more appreciable. But when, through the means of the physical and other general symptoms it has been made out on what cause the dyspnœa depends, then this symptom often becomes a valuable measure of the increase or diminution of the disease, and a useful guide of practice.

PROXIMATE CAUSES OF DYSPNŒA, OR DIFFICULT BREATHING.

1. BY IMPEDING THE ACCESS OF PURE AIR TO THE LUNGS.

a. *Mechanical.*

Rigidity of parts of the respiratory machine	} e. g. {	Ossification of cartilages; induration of the pleura; rickety distortions.
Pressure on ditto	. e. g.	Tumours or dropsies of the abdomen.
Obstructions of the air- tubes	} e. g. {	Effusions in, swellings of, tumours pressing on, the air-tubes.
		Spasm of the glottis; spasm of the bronchi.

may intrude. But the other parts of the tubes have also a preserving sensibility, which may bear a little, but is soon roused into activity by continued irritation. We find the parallel of this in the alimentary canal in the natural state. The sensibility that excites the action of vomiting is peculiar to the fauces at one end of the tube; and that which induces the striving of defæcation resides chiefly in the termination of the rectum at the other end: but uncommon degrees of irritation, or an exalted sensibility, will occasion the same actions to be excited by impressions on other parts that are usually insensible: hence arise the vomiting caused by an over-irritated or inflamed stomach or duodenum, and the tenesmus and purging excited by a similar state of the colon. We shall see this more fully on considering the various causes of cough.

As other irritations, cough may be excited either by an unusual irritant acting on the tubes in their natural state, or by the ordinary circumstances, which, although not usually irritating, yet become so by the exalted irritability of the tubes, or, as is the more common case, by a combination of these causes. We have an example of cough excited simply by an unusual irritant, when a portion of food or of bronchial mucus lodges on the membranes of the glottis; and an irritant may act by sympathy as well as by direct application, as when we excite coughing by introducing a probe pretty far into the ear. The cause by increased irritability is exemplified in the cough of early bronchitis and nervous asthma, which the mere inhalation of air is sufficient to excite. There are both an unusual irritant and increased irritability, in the secreting stages of bronchitis and other affections, where an unusual quantity, and sometimes an irritating kind, of mucus is poured out on an over-sensitive membrane. This more complex cause of cough is frequently induced by the continuance of the other causes; thus, the continued application of an irritant will develop an increased sensibility; an increased sensibility and irritation will be followed by inflammatory excitement and the secretion of matter, the quantity and quality of which add to the irritation. Thus we see how the physiological causes of cough become identified with the pathology of bronchitis, or inflammation of the membrane of the air-tubes; and, in common parlance, a bronchial inflammation is called a *cough*, this being the most prominent symptom. But although this inflammatory condition is often developed by the continuance of causes which produce cough, yet it is not necessarily so, and there may be irritation or increased sensibility, or both, enough to cause cough, and which may yet be short of the degree or the conditions requisite to produce inflammation.

It has been stated that the irritation which causes cough may not be applied to the bronchial membrane itself, but may be exerted from a part more or less distant. Thus cough may be excited by tubercles in the parenchyma of the lungs, by inflammations or irritations of the pleura, peritoneum, stomach, liver, and so forth; and although we may conjecture that these irritations are conveyed through the nervous branches which connect these several organs and the air-tubes with one common sensitive centre, yet we cannot explain why they should be sometimes conveyed, and at others not; for although cough does frequently accompany the pathological conditions to which we have just adverted, yet irritations and inflammations of the stomach, liver, peritoneum, nay, sometimes even of the pleura and pulmonary parenchyma, often arise without any cough whatever. It has been attempted to explain these discrepancies by assuming that there must be bronchitis present to produce cough, and that, when these several distant irritations do not excite bronchitis they are unaccompanied by cough; but this view increases instead of diminishing the difficulty, for it leaves unexplained the reason why this supposed bronchitis should occur in some cases and not in others; and bronchitis, although including cough, is more than cough, and needs something more to produce it. We may conjecture about local weaknesses, constitutional peculiarities, and irregular sensibilities, as causes of these differences, and this is all that we can do towards explaining them: but this is not what an explanation ought to be; this is referring phenomena not to known general properties, and the

laws which govern them, but to individual peculiarities and undefined influences, the laws of which are not known. These considerations furnish another proof of the uncertainty of general symptoms as means of diagnosis. Still, when cough does occur, and its cause has been made out by the aid of other signs, it deserves attention, not only as a symptom, but as a morbid action of a distressing and hurtful kind, which sometimes may require remedies expressly to relieve it. This illustrates what has been said before, that general symptoms, although much less constant and instructive than physical signs with regard to the diagnosis of organic lesions, yet, when positive, often tell us more of those general conditions of the system, which become our guides in the employment of remedies.

Under this impression we shall examine some of the varieties of cough which present themselves in different cases, and trace the connexion between their characters and variations in the elements that constitute them. Of course the study of a symptom in any individual case must be conjoined with a proper survey of its functional or organic cause; but as we have also (sometimes only,) to treat the symptom, it is highly useful to study its varieties, and thus to render it more practically instructive.

The cough may vary according to, 1. The irritant exciting it; 2. The sensibility feeling the irritation; 3. The movements thereby excited, which consist of (*a*) the contraction of the muscles of respiration, and (*b*) the contraction of the air-tubes; 4. The condition of the bronchial membrane and its secretion.

Under these heads, we shall meet with the varieties of cough with which every practitioner is familiar.

1. The violence of a cough will, *cæteris paribus*, be in proportion to the degree of irritation that excites it. For example, a healthy person whilst eating or drinking incautiously, suffers some food to enter the glottis; the cough thereby excited will be more severe with wine or any thing peppered, than with water or any bland food. So in the early stages of catarrh, although the sensibility of the membrane is increased, yet the thin saline-tasted secretion also acts as an unusual irritant upon it, and keeps up a short teasing tickling cough, with continued attempts to clear the throat. When the irritation is more moderate, but irremovable, like that occasioned by incipient tubercles in the pulmonary tissue, the cough will generally be of that slight *hacking* kind, with little or no expectoration, that is so well-known as one of the first symptoms of pulmonary consumption. The irritant here remaining the same, the circumstances which increase this cough are those that augment the sensibility of the lung and air-tubes, such as a quickened state of the circulation from exertion, heated rooms, or during the assimilation of stimulating food.

2. We have already adverted to increased sensibility as being concerned in the cough of recent bronchitis or bronchial irritation. It becomes, however, more developed when the cough has lasted several hours, and instead of being short and tickling only, it comes on in more violent and prolonged fits, which are quite irresistible, and often accompanied by a feeling of soreness. The heightened sensibility of the air-tubes is farther manifested by the readiness with which breathing air at all cold, or swallowing any thing at all irritating, will excite cough. We have before remarked how this increased irritability of the inflamed air-tubes is commonly joined with the augmented irritation of their secretion; but we do sometimes meet with cases in which the increased sensibility is purely nervous, unaccompanied by any secretion; and the cough is brought on by the slightest cold or irritating matter in the air. Even strong odours will sometimes cause it. These nervous coughs are to be treated chiefly by various remedies which diminish the sensibility of the nervous system, such as narcotics, or sometimes by those which excite stronger impressions in other parts, such as epispastics and the application of heat.

3. Besides the sensibility of the bronchial membrane, another property connected with the nerves, muscular mobility, may be the source of some varieties of cough. We cannot here examine the circumstances under which a change of proportion;

ate relation takes place between the action of the motory nerves in general, and the impressions which excite them. It is sufficient for us that the fact is well known, that in certain conditions or states of the system, an ordinary impression will excite inordinate motions; while in others the motions resulting from similar impressions will be imperfect, and below the natural amount. It is thus also with the motions of muscles concerned in coughing; they may be excessively mobile, so that the least irritation will set them a going; and, like a clock without its pendulum, they continue their impetuous motions, until their strength has fairly run out. This is the *convulsive* cough which we meet with in some hysterical and nervous subjects, and its convulsive character is the more evident from the fact, that it sometimes alternates with chorea, or convulsive affections of other sets of muscles. The same uncontrollable character is, however, often communicated, by a nervous temperament or peculiar nervous affections, to coughs arising from common causes, which thus shake and exhaust the patient in an unusual degree, and require appropriate modifications of treatment to subdue them. Hooping-cough in its after stages is of this kind, and from our experience we should say, that the shaking uncontrollable nature of the cough is more characteristic of pertussis, than the hooping, which is not always present, especially in adults. This leads us to consider on what hooping depends; and here again we shall find the use of our physiological divisions, which explain some other varieties of cough that are sometimes met with.

In considering the physiology of respiration, we are led to believe that the act of expiration is aided by the contraction of the circular fibres of the air-tubes. In the forcible expirations which constitute ordinary coughing, there is also a simultaneous contraction of the air-tubes, and especially of the aperture of the glottis, through which the air is driven with the greatest force, in order to expel any irritating matter. Now the contraction of these tubes may be excessive, defective, or irregular, and this will occasion other varieties of cough. When their contraction is excessive, being also generally irregular, they give the *wheezing* character to the cough, so remarkable in asthmatic subjects. A wheezing cough does not always depend on contraction of the circular fibres, for other constrictions of the bronchi will also cause it; but if we listen to the chest of a nervous asthmatic, we may often hear, in the forcible expirations of a fit of coughing, sibilant and sonorous rhonchi, which are too transient to be produced by the thickening or secretion of the tubes. Where the irritability of the bronchi is great, their contraction may not, as usual, cease during the act of inspiration; and it is this spasmodic constriction affecting particularly the upper part of the air-tube during the forcible inspiration which succeeds to coughing, that causes the *hooping* sound. This state of things happens chiefly in the irritable frames of children when affected with convulsive cough; and the violence and repetition of the expiratory efforts of this cough occasion the back draught to be more forcible, sonorous, and prolonged. If we apply our ears to the chest of a child during a fit of hooping-cough, we are surprised to find how little sound we can hear there with all these noisy external efforts; in fact, the continued constriction of the bronchial tubes permits very little motion of air into and out of the tissue of the lungs: in the convulsive cough of adults, again, in which there is seldom hooping, the respiratory murmur of the long inspiration, or back draught, is pretty loud, whilst the succession of coughs here also consists more of external than of internal movement. In all these kinds of cough, antispasmodics will often give more relief than any other class of remedies.

But we have an opposite condition of the circular fibres of the bronchi, a weakness or deficiency of action, a paralysis, so that they do not contract as usual during the expiratory efforts of coughing. This constitutes the *hollow* or *barking* cough which we sometimes hear in chronic bronchitis, and now and then in febrile and nervous affections. This cough is, as we shall presently find, accompanied with a difficulty of expectoration; hence it is sometimes very distressing, and

particularly so when, as it occasionally happens, it is combined with a mobility of the external muscles of respiration, rendering the cough convulsive and paroxysmal. The tearing and exhausting fits of this kind of cough are sometimes quite agonizing; and we may judge from the bloated, congested appearance of the lips and face, how much these fits impede the respiration and circulation, and how much they may thus tend to increase and perpetuate the diseased condition of the bronchial tubes. In some such cases we have seen the terebinthinaceous medicines, with external counter-irritation and occasional emetics, give most relief; but the treatment will depend on various circumstances, which cannot be entered into at present.

4. Besides the sensitive and motory apparatus concerned in the act of coughing, we have the secretion of the air-tubes, which may also by its qualities modify the character of the cough. According to whether this secretion is present or not, the cough may be humid or dry; and according to the relation of the qualities of this secretion to the powers of expectoration, the cough may be loose or tight; and these varieties may be combined with the other species of cough, as those may with each other; and thus are produced the endless host of different kinds of cough that we meet with in practice. Without pretending to affirm, that it is always possible to classify these by the division now pointed out, we may state that we have often found this analysis useful in drawing attention to the predominant changes of vital property, as manifested by symptom, and in thus distinguishing cases which require different modes of treatment.

Expectoration. The expectoration is another symptom of thoracic disease, which must be considered as the result of vital as well as physical properties, and therefore it is included under the head of general diagnosis, although it sometimes approaches in character to a physical sign. The word expectoration strictly means the act of expelling any thing from the chest; but by a figure of speech it is also applied to the matter so expelled. We shall find that both the act and the matter of expectoration may present us signs of the condition of the pectoral organs.

If we consider the structure of the bronchial tree, we shall perceive that natural breathing tends to prevent the accumulation of matters in its tubes, in spite of gravitation. The area of the smaller divisions of the bronchi is considerably greater than that of their trunks; and it may be represented as the divided base of a hollow cone or funnel, which is concentrated gradually in the trunks, and completely in the windpipe. The air, in the more sudden act of expiration, passes with greater rapidity and force as it converges into these trunks, and therefore tends to carry through them any superfluous matter that may be present on the bronchial surface. This will explain how the finer bronchial tubes of the most dependent parts of the lung are, in health, kept clear of any accumulation. Possibly the ciliary motions of the mucous membrane may, as MM. Purkinje and Valentin have surmised, tend to the same effect.

But it is the forcible acts of special expectoration, *hawking*, and coughing, that tend most effectually to clear the air-passages; and they do this by both increasing the force and fulness of the expiratory effort, and at the same time contracting the upper tubes and trachea, so that the air acts with greater force on any superfluous matter in them. The repeated closure of the glottis in coughing increases the expulsive effort by letting out the air in successive sudden jerks, which are more forcible than any continued act of expiration would be. We see this exemplified in cases where the operation of bronchotomy has been performed. The patient often cannot expectorate effectually so long as air can pass out from the artificial opening, and he is in danger of suffocation in consequence; but on closing this during the act of coughing, the force of the air can be directed in the natural way against the accumulated matter. By attention to this particular, suffocation has been averted in more than one instance after this operation. In certain diseased conditions of the larynx, the patient cannot close the glottis; and

hence also expectoration may be difficult, while the cough assumes a continuous uncontrollable character, which we might have added as another variety to those before enumerated. This is what M. Trousseau calls a belching cough.

There is another element essential to the proper performance of the act of expectoration—the capacity to make such a full inspiration as shall carry the air in beyond the accumulating matter, so that it may on its forcible passage out again, carry this matter before it. Hence we see why weakness, which prevents a sufficient inspiratory effort, or obstruction of the terminal and most expandible parts of the air-tubes, which renders this effort ineffectual, may stop the act of expectoration, and by permitting the accumulation of matter in the air-tubes may speedily conduce to a fatal result. Inability to expectorate is the immediate cause of death in many cases of various diseases; in fact, it is a part of the article of death itself; and when we hear the rattle in the throat of the dying, we hear the sign of the accumulating barrier which is shutting out the breath of life. Sometimes, even at this stage, there are sensibilities enough in the system to feel the force of a stimulant which may excite the sinking powers to another struggle; expectoration is once more accomplished, and breath once more renewed; and where there is no irrecoverable alteration of structure, this act of expectoration may in some few instances turn the balance in favour of recovery. It is unnecessary to say, then, how important it is to study the act of expectoration, and to acquaint ourselves with those means that may excite or promote it. Most practitioners have seen instances in which a patient has been snatched from the jaws of death by the timely administration of a diffusible stimulus, such as a warm aromatic draught, with carbonate of ammonia or ether, together with such a change of posture and other circumstances as might most favour the explosion of the matter that was suffocating him. A great deal may often be done in less urgent cases by attention to the posture of the patient.

This is particularly the case with children, and with aged patients who have nearly as much difficulty in expectorating as children. They should never be suffered to lie for many hours in the same position, and children should not even be permitted to sleep many hours at a time if the secretions of the lungs are retained. G.

In most instances the act of expectoration is easiest in that posture in which the respiration is most free, which is commonly the semi-erect posture: but some patients expectorate more freely when lying on one side; and we remember a phthisical patient who really appeared to be several times saved from suffocation by alternating his posture from lying down to sitting up in a particular manner, suggested by a knowledge of the condition of the lungs in that case. When this expedient was neglected, the patient was so shaken with frightful fits of fruitless cough, and so oppressed with the accumulating matter, which they could not expel, that speedy suffocation seemed inevitable. In some cases, the act of expectoration may be favoured by another kind of action, in which the expiratory muscles are concerned, that of vomiting; and we shall find hereafter, that some emetics may exert an influence of an important nature on the bronchial tubes, besides this mechanical one.

The character of the expectoration frequently furnishes us with very instructive signs. It is the product of diseased action, and in its physical or chemical qualities it may inform us somewhat of the nature of that action, of the condition, and sometimes of the position of the parts from which it comes. As, however, we have seen that the effort of expectoration is sometimes unsuccessful, there may be no expectoration to judge of; and besides this instance, most children and some adults cannot spit out what they expectorate, but swallow it.

The basis of expectoration generally is the secretion of the mucous membrane of the air-tubes. This is naturally a transparent, colourless, slightly glutinous liquid, like thin mucilage. The chief animal matter which it contains is that called mucus, which seems to be a sort of imperfectly coagulated albumen, and

the varieties of sputa presented by disease commonly depend on an unnatural condition or quantity of this animal matter. There is also saline matter, which may vary in quantity, and so may the proportion of water. From the recent experiments of Dr. Golding Bird, as well as those of Dr. Babington and Mr. Brett, it would seem that the condition of animal matter in the expectoration depends in great measure on the proportion of saline matter with which it is combined, this being in abundance in transparent and viscid expectoration, and defective in the opaque kind, with little viscosity, and least of all in that which is absolutely purulent. Dr. Babington found, that on mixing pus with a solution of common salt, after a time it became converted into a nearly transparent viscid mass like mucus; and Dr. G. Bird rendered the physical and chemical resemblance perfect by adding a little soda, and then passing a current of carbonic acid gas through it. (*Guy's Hospital Reports*, No. vi.) Mr. Brett, in a valuable communication to the medical section of the British Association in 1837, states that he found the saline matter of transparent viscid mucous expectoration to amount to from 20 to 33 per cent. of its solid matter, whilst that of the opaque viscid mucus of chronic bronchitis was from 16 to 23, and the puriform expectoration of the last stage of phthisis was only from 9 to 10 per cent. These researches confirm the opinion we have long held, that the difference between mucus and albumen seems to consist in their physical condition, rather than in their chemical constitution. Mucus is a transparent glutinous matter, not coagulable by heat, as liquid albumen is, and not solid and opaque like coagulated albumen; but on ultimate analysis it is not found to differ from this principle. When, therefore, we see expectorated matter opaque and solid, or liquid and coagulable by heat, it loses the only distinguishing characters of mucus, and is strictly albuminous. For this reason, we submit the following general classification of expectorated matter:—

1. *Mucus*, more or less transparent and viscid. 2. *Albuminous*, opaque without viscosity. 3. *Watery*, thin and transparent. 4. *Compound*, composed of combinations of the preceding kinds.

1. *Mucous* expectoration is that most like the natural secretion, being transparent, and more or less viscid. It is the general result of simple acute inflammation of the mucous lining of the air-tubes, in which case it is increased in quantity, and particularly in viscosity; in fact, the glutinous character of the sputa, and the tenacity with which they stick together and to the containing vessel, or fall out in a ropy mass, was described by Andral, and we think correctly, to be a mark and, in some degree, a measure of acute bronchitis. From the researches just alluded to, it would appear that the viscosity of these sputa depends on their quantity of mucus, which is albumen combined with saline matter, to which is sometimes added free uncoagulated albumen. In the most intense forms of inflammation, and where the disease occupies the finer tubes, to the glutinous character of the mucus is added a frothiness, arising from the mixture of those air-bubbles in the tubes, which in their breaking cause the mucous and sub-mucous rhonchi. But the most intense bronchitis is that accompanying inflammation of the parenchyma: here we have the most viscid form of sputum, through which air driven produces the crepitant rhonchus; and the blood in the distended vessels of the engorged parenchyma communicating a little colouring matter to it, gives it that reddish or rusty tinge which is so characteristic of the sputa of peripneumonia. The transparent or semi-transparent condition of these viscid sputa distinguishes them from the albuminous kind, into which, however, they pass in the advanced stages of all the more inflammatory affections of the bronchial membrane. The mucous expectoration has commonly a saltish taste, and with its saline matter is probably connected its irritating quality, so marked in the early stage of bronchitis.

2. The varieties of *albuminous* expectoration are pretty numerous, for under this head are comprehended the opaque kinds of sputa which have no remarkable viscosity, such as the purulent expectoration of chronic bronchitis, the fibrinous or polypous sputa of plastic bronchitis, and the more compound combinations of

these with caseous and other matters, which are voided in the advanced stages of pulmonary phthisis. This class of sputa denotes an error of secretion, farther than the mucus from the natural standard, there being a defective proportion of saline matter, as well as an excess of albuminous; but their production generally announces a decline of inflammation from its most acute form. Probably, the very throwing off of so considerable a mass of animal matter, is the means of relieving to a certain extent the inflamed vessels; for we frequently find the purulent or polypous expectoration in intense bronchitis attended by a remarkable diminution in the signs of local and general excitement. This remark has been made also by Dr. Stokes. But such an expectoration ceases to be a favourable sign when it *continues*, either with undiminished irritation, or with proofs of general weakness; for then a change is implied, either in the structure, or in the habitual action of the membrane, which, secreting pus instead of mucus, goes beyond the mere removal of a temporary congestion, and proves itself a cause of irritation and exhaustion.

Much has been written about the modes of distinguishing pus from mucus in the expectoration. On these formerly the diagnosis of pulmonary phthisis was supposed to depend. These tests are not now much attended to, not only because it is well known that pus may be produced without any ulceration or consumption of the lung, but also because these distinctions cannot be complete between matters that pass by insensible gradations into each other. The chemical composition of pus resembles that of the colouring globules of the blood, and differs from mucus in containing a notable quantity of iron.

3. *Watery* expectoration is that kind in which a liquid of only slightly glutinous quality is coughed up in greater or less abundance. This appears to contain very little animal matter, and to be rather a diluted mucus than to have in it any thing peculiar. It is often covered with a froth, particularly when it is coughed up with much effort. This secretion is to be regarded as the result of irritation, with a relaxed state of the vessels, rather than of inflammation; but it may occur as a consequence of this lesion, as well as of congestion or obstruction to the circulation of the blood in the lungs. It is the expectoration of what is called humid asthma and pituitous catarrh. Some persons of a relaxed habit have it during a common cold, or any form of bronchial inflammation. It sometimes tastes more salt than usual, and in this case it commonly causes a more incessant teasing cough.

4. Under the head *compound* expectoration, are classed various combinations of the preceding kinds, which we meet with in almost every form of pectoral disease. They are either products of different parts, in distinct pathological conditions, although coughed up at the same time; or they may in some cases proceed from the same part in an intermediate pathological state, and capable of secreting different kinds of matter. An example of the latter is the opaque or muco-purulent expectoration of the latter stages of bronchitis, in which the opacity and colour of albuminous matter is apparent, whilst it is held together by a mucus of some tenacity. In the *concocted* sputa of declining acute bronchitis, the mucus predominates; whilst the loose albuminous matter is more abundant where the inflammation tends to pass into a chronic state. The sputa of chronic bronchitis, and in fact of most chronic diseases of the lungs and air-tubes, are almost always more or less mixed; for it generally happens that the different parts of the membranes and tissues are variously affected: and when, as in the advancing stages of phthisis, there is structural lesion or destruction of parts, there is the greater reason for a more heterogeneous kind of expectoration. In these cases, however, the albuminous kinds mostly predominate, in the form of muco-purulent, purulent, caseous, or tuberculous matter, and coagulable or fibrinous lymph, occasionally tinged or mixed with the colouring matter of the blood: these constitute the bulk of the expectoration of the consumptive. In catarrhal diseases of a chronic kind, we commonly see very opposite forms of sputa expectorated together. Thus in a spitting-dish full of thin, frothy watery expectoration, we often find portions of tough and almost solid semi-transparent mucus, as if some parts of the tubes were throwing off the

water, and others the animal matter, in a separate form. When the subject of catarrh is treated of, we shall find that these opposite products do not imply an equally opposite pathological condition. After hemoptysis, it is very common to see fibrinous concretions, together with purulent and mucous matter, all more or less tinged with blood. In other affections it is not uncommon to see the sputa streaked with blood; and this sign is of less importance when the cough is violent, because it may then merely proceed from a slight abrasion caused by the force of this mechanical action. When, however, there is often blood present, without much force of cough, and especially if there be pus with it, we may suspect the presence of ulceration in some part of the air-passages. The colouring matter of the blood in an altered state, may also be combined with other forms of sputa. Thus, in scorbutic persons affected with humid catarrh or bronchitis, the expectoration is a thin, reddish-brown liquid, like prune juice or diluted treacle; and in the last stages of pulmonary disease, the colouring matter, from the final pulmonary congestion which precedes death, is seen in the dirty reddish-brown or greenish tinge of the purilaginous sputa.

It is evident then, that the matter of expectoration will often inform us of the pathological condition of the lungs and their tubes; and its quantity or quality may sometimes suggest proper remedies. In some cases we may learn other things from it. Thus, when in consumption, tubercular matter with portions of pulmonary tissue is expectorated, the conclusion is obvious. We also sometimes see the expectoration present physical signs of the state of the interior by its containing albuminous or compound matter, moulded into the shape of the tubes or cavities from which it comes. The large rounded flocculent muco-purulent sputa of advanced phthisis are often such as could only accumulate in a cavity; and that the tubular or vermicular albuminous matter which is coughed up in the plastic kind of bronchitis, sufficiently explains whence it comes, by its being an exact mould or cast of the bronchial tubes, sometimes in an aborescent form, from several of their divisions.

We must not omit to notice a test, which is erroneously used to determine the nature and source of sputa, whether they float or sink in water. The floating of a sputum merely depends on the number of air-bubbles, retained in it, and although pus alone, or tuberculous matter alone, will not retain these bubbles, yet a small addition of tenacious mucus will enable them to do so. Again, although the sputa formed in ulcerous cavities are less likely to contain air and to float than those formed in the tubes, yet we not unfrequently find the congested expectoration of acute bronchitis, which is formed exclusively in the large tubes, sink in water; whilst the mixed product of a vomica and the adjoining tubes, which has been churned together with air, floats. This hydrostatic test of expectoration is then a very inconclusive one; but it may be useful in sometimes causing a rough separation of the albuminous matters from those of a more viscid mucus kind.

Other details regarding the matter of expectoration might be given; but enough has been said to illustrate how it may prove useful in diagnosis and practice. From this it will appear how much more valuable its indications may become when conjoined with the physical signs, by which we may often detect the position, and measure the amount of the local disease, of which the matter expectorated is the product. We shall find many exemplifications of this position hereafter.

Pain. The only other morbid phenomenon, connected specially with the modified vital properties of the organs of respiration, is *pain*. We know that pain may arise either from an excessive impression on the nerves of sensation, or from an excessive sensibility of these nerves, to which common circumstances of position, motion, &c., then become painful. The latter is the more common cause of pain in internal diseases; but it is not unusual to find them combined, as when a tumour, or effused matter, presses on or stretches parts morbidly sensible. The most common causes of pain are inflammation, and those kinds of vascular excitement that are allied to it: this vascular excitement is generally

attended, in the first instance at least, with exaltation of the nervous function. But the nervous function may be *primarily* excited; and although the increased sensibility thus produced seldom lasts long without more or less stirring up the function of the vessels also, yet we may for a time have pains purely nervous, such as pleurodyne and pectoral neuralgia. Farther, as inflammation is not the only cause of pain, so the pain present in inflammation is by no means an index of the extent of the inflammation, nor even of its situation. Most extensive inflammations have been known to occur, not only in the parenchyma of the lungs, but in the bronchial membrane and pleura also, without producing any pain; and it frequently happens in phthisis, that the pains chiefly complained of are low down in the sides, when the disease is almost entirely in the upper lobes of the lungs. So likewise in bronchitis and pneumonia, the pain is often confined to the sternal, lateral, or scapular regions, whilst the disease occupies other parts.

There are, nevertheless, some general characters with regard to pain, which may render it useful as a symptom of disease of the chest. It is commonly remarked, that the pain of parenchymatous and bronchial inflammations is dull and diffused, whilst that of inflammation involving the serous and fibrous membranes of the pleura and pericardium is of a sharp lancinating character. This is generally but not constantly true; and we may find it explained by the circumstance, that the par vagum, which supplies the bronchi and lungs, is by no means so sensitive a nerve as the spinal intercostals, which are distributed on the pleura and pericardium. For this reason, too, there is more apt to be acute pain when the costal pleura or the coverings of the great vessels are inflamed, than when the pulmonary pleura is the chief seat of disease. A farther distinction in the variations of these divers kinds of pain will confirm the opinion, that they belong to different orders of sensibility. The dull, heavy, or aching pain of bronchitis, or pneumonia, is generally pretty constant, although it is increased by full inspiration, exertion, or the breathing of cold air; yet even then it gives the feeling of soreness under the sternum, rather than of severe pain. It often resembles the pain of dyspepsia, which is probably seated in a branch of the same nerve, and is also usually referred to the sternum. The degrees of pleuritic pain, on the other hand, are sudden, extreme, and intolerable. If it be not felt in ordinary breathing, a long breath, or a cough, just sufficient to bring the membranes to a requisite degree of tension, causes that sharp stitch of the side—that sudden catch of the breath, that has been considered so characteristic of pleurisy. When it is constant, the patient is obliged to hold his side to diminish its severity, by restraining the motions of the chest; and thus placed in opposition to the sensation which prompts the act of respiration, this sharp pain may cause such a voluntary restraint of these acts, as to bring the patient to the verge of asphyxia. It is under these circumstances that the breathing becomes partial, as formerly described, and patients whom pain constrains to breathe only with the diaphragm or with one side, will perform this supplementary respiration so well, that they are completely free from pain, although the inflammation is as acute and the membranes as tender as ever. Sometimes we may detect the latent tenderness by pressing between the ribs of the affected side; but we are more likely to succeed if we restrain the supplementary respiration by pressing on the abdomen or on the healthy side, and then desire the patient to cough, or to take a sudden long breath. If there be any exalted sensibility or tenderness, it is pretty sure to be discovered by this means; and we have several times met with patients who denied having any uneasiness or tenderness, yet they winced at the pain developed in this way.

As a general rule (not however without some exceptions,) we may consider a fixed permanent pain, or a permanent tenderness, which depends on the same pathological cause, an indication of inflammation, or congestion, or some analogous condition of the vessels; and when present it deserves attention, not only as an object of treatment on its own account, but also as an index, which together with the pulse, cough, fever, and other general symptoms, shows the increase

and diminution of the complaint, and the effects of remedies, even before these become manifest from the physical signs. Still, if we trust to it alone, it will negatively deceive us in those numerous cases of extensive disease in which it is absent, or scarcely complained of; and it will positively deceive us in those cases in which modified nervous sensibility—a mere neurosis—is the only or the chief disorder.

We come now to examine shortly the nature and value of the symptoms which diseases of the organs of respiration develop in other functions.

Physiology indicates the close relations which subsist between the organs of respiration and those of circulation; and prepares us to expect that the disease in the former should disturb the latter, and develop symptoms in the function of circulation. Accordingly we find such symptoms in the state of the *arterial pulse*, and in that of the *superficial capillary* and *venous* parts of the circulation.

The pulse. The pulse has for ages been relied on as a guide in the diagnosis and treatment of all diseases; but those who have had much experience, know how fallacious it sometimes proves; and those who have had little experience must acknowledge that it is very difficult to distinguish the varieties of the pulse from one another. Some of the fallacies and difficulties connected with the pulse as a sign, appear to arise from our studying it too empirically,—from our not rationally considering those elements on which its varieties depend, and a knowledge of which would enable us to understand and to foresee the circumstances which are capable of producing these varieties. To guide the student to this knowledge, we will give a brief analysis of the nature and varieties of the pulse of arteries.

The arterial pulse is caused by the jets of blood thrown at certain intervals of time into the arteries by the contractions of the ventricles of the heart. The motion originates exclusively in these contractions, although it may be modified by the blood which is moved, and by the tubes which convey it. Now here are three elements:—1. The heart; 2. The blood; and, 3. The arteries;—and variations in the condition or action of each of these cause varieties in the arterial pulse. Let us consider a few of these variations.

1. Without noticing the modifications in the action of the heart resulting from disease of that organ—a subject to be considered hereafter—it is plain enough, that if the other elements be equal, the strength and frequency or rhythm of the contractions of the left ventricle of the heart, will determine the *strength and frequency* of the arterial pulse. But the contractions may have another quality—that of abruptness: being rather brisk and short than strong and complete, they communicate to the pulse that character which is called *sharp*. Now what property in the heart gives it this abruptness of contraction? what but an extreme irritability? There is sometimes this irritability in inflammations and fevers; but we find it also in conditions of mere nervous irritation, of which it is more distinctive. And it is when these coexist with inflammation or fever, that the pulse presents a sharpness, in addition to other qualities more peculiar to inflammation. In sthenic irritation, or those connected with fulness and tone of the vascular system, which may tend either to acute inflammation or to active hæmorrhage or other discharge, the heart's contractions are strong as well as sharp; and so is the pulse. In these cases, although the original irritation were local, it has now reached the centre of the circulation, and thence, distributed through the whole system, becomes general. But let us see how the other elements modify the pulse.

2. There can be no doubt that the blood in the heart and vessels determines by its *quantity* the character of the arterial pulse: very possibly it does so by its *quality* likewise; but this is not so easy to prove. The fulness and strength of the pulse in the arteries depend materially on the quantity of blood in them; and when the pulse is frequent as well as full, there is the greater proof of plethora, inasmuch as it shows that there is a considerable jet thrown into the arteries at each contraction, notwithstanding that the contractions are so frequently repeated.

But there may be a full system of blood-vessels without a large or strong pulse,—as when the heart is acting feebly or faintly; and where its irritability is lowered, such a mode of action may be actually caused by the congestion or distention which for a time oppresses the function until it is roused into reaction. Under these circumstances, blood-letting will often increase the fulness and strength of the pulse. The opposite condition—a defective quantity of blood—will modify the pulse differently according to the state of the other elements, the action of the heart, and the arterial nerves. When the irritability of the heart is reduced, together with the quantity of blood, the pulse will become softer, weaker, and less frequent. But it frequently happens, especially in nervous temperaments, or where the depletion has been carried to excess, that the diminution of the blood is accompanied with an augmented irritability of the heart, and the pulse becomes not only quicker, but sharper than usual; and the effect of the abrupt jets into a small bulk of blood contained in imperfectly distended tubes, is to give to the pulse that jerking or bounding character, as if a mere ball of liquid were suddenly shot through the empty tube, which is so remarkable in the irritation of inanition and chlorosis.

3. But we cannot fully understand the variations of the pulse without attending to the properties of the tubes in which it is felt. If the arteries were tubes of an unyielding or an unvariable character, then the pulse in them would more uniformly represent that of the heart, which would be transmitted through them unmodified. But we know that they are not so: they possess properties of elasticity and tonicity, which vary according to circumstances, and which modify the pulses from the heart, by changing the size of the tubes, and the yielding or the resisting nature of their walls. It is plain that the impulse of a jet of blood must be differently transmitted by vessels when they are large and yielding, and when they are contracted and tense: in the first case the pulse would be *soft* and *full*, in the latter *hard* and small. We know but imperfectly what are the circumstances which affect the tonicity and elasticity of the arterial coats, and thereby the pulse: farther experiments are wanted to elucidate them, but the following are pretty well-ascertained, and they should not be forgotten in estimating the signs of the pulse. Cold causes the arteries to contract, and therefore renders the pulse smaller. We know how a cold lotion will often diminish the fulness and throbbing of the arteries of an inflamed part; and we have seen the same effect of cold more strikingly produced in the large arteries. In the experiments on the sounds of the heart carried on in February 1835, we repeatedly observed, that when the aorta of an ass, recently killed, was plunged into cold water, it contracted, so as not to permit the introduction even of the little finger, and its coats acquired an increased thickness and rigidity: the pulmonary artery did not contract nearly so much. The circumstance of temperature must therefore be taken into account in judging of the pulse; for cold may render the pulse of an artery small and hard, or, if severe, small and weak, when the action of the heart and the condition of the system would give it the reverse qualities. Heat, on the other hand, within certain limits tends to diminish the tonic contraction of the arteries; so that under its influence they receive more strongly and fully the pulse from the heart. We know how warmth restored to a limb makes it throb with these expanded pulses.

But there is another circumstance that may modify these actions of heat and cold on the pulse, besides proving by itself a cause of modification—the condition of the capillary circulation. When this is not free, the artery will be more distended, and therefore the pulse harder and stronger than usual; and thus in fevers, where the surface is pale and constricted in the cold stage, and dry and unrelaxed in the hot stage, the pulse often preserves through these changes of temperature a hardness and strength which would be much more varied were the capillary vessels free and exhaling their usual excretion, and which is actually diminished under the influence of a warm bath or temporary moisture of the skin, although the fever still continue. Again, whatever view we take of the nature of inflammation, we cannot, in the present state of pathological knowledge, doubt that the circulation

through the inflamed vessels is to a certain degree obstructed; whilst, either as a consequence of this, or from some co-operating influence, the vessels leading to the part become dilated, and being thus more open than others to the pulse-wave from the heart, which their distended coats cannot temper as usual, they become the seat of that throbbing hard pulse, that has been mistaken for increased action of the vessels themselves. And there are many other variations in the pulse explicable on these principles, but this is not the place to consider them farther in detail.

There is, however, one more cause of variety connected with the arteries, so frequently occurring, that it must not be overlooked, viz., the difference in the arteries of different individuals. Without any adequate difference in the action of the heart, in the quantity of blood, or in the temperature, we find a very remarkable variety in the character of the pulse in different healthy individuals; and the same difference extends to the modifications of disease. Some have always a soft large pulse; in others it is small and feeble; in others small and hard: others, again, have habitually a hard strong pulse, which scarcely becomes soft under any circumstances. The first depends on the arteries being large, with thin elastic coats. The small feeble pulse may result from their small size and thin coats: this is common in females, and may coexist with inordinate action of the heart. The hard wiry pulse is connected with small arteries with rigid coats; and the same rigidity or deficiency of elasticity in the coats of arteries of larger size gives that unvarying hardness and strength to the pulse which we so often meet with in old people, and which renders it so uncertain a sign in these cases. We may often, in the radial artery, feel the permanent thickening and hardness of its coats, which thus, like a tube of glass or metal, rigidly transmit the heart's pulses, without tempering them by any yielding or spring. With these peculiarities of pulse there are often connected characters of constitution or temperament, and proclivities to disease or health, which are of great importance in guiding us in practice.

Besides the general causes which modify the pulse, which we have now briefly considered, there are some specially connected with diseases of the pectoral organs. Those arising from diseases of the apparatus of the circulation will be treated of in the article devoted to that subject. But severe affections of the respiratory organs also sometimes signally modify the pulse, and that in a manner which may tend to confuse its indications. We know how closely the heart is linked with the lungs; by the circulation even more closely than by mere positions; for the lungs may be said to lie between the two compartments of the heart, and any considerable obstruction in the lungs will derange the usual relations of these compartments. There is then a distention or over-stimulation of the right side of the heart; while the left, receiving a diminished quantity of blood from the lungs, and that not thoroughly aerated, is less excited than usual, and may give to the arterial pulse a character of weakness and smallness that by no means represents the condition of the whole vascular system, and which often is remarkably contrasted by the action of the right side of the heart, as felt or heard under the sternum. These varieties are produced by any of those affections of the chest which infringe far on the respiratory function. These are more commonly those of the bronchial and parenchymatous kind, which have accordingly been described to be accompanied by a softer and weaker pulse than those affecting the serous membranes. But a pleurisy may occur also with a small weak pulse, when the effusion or pain is such as to interfere largely with the function of the lungs. Neither is it to be supposed that the pulse in severe pneumonia or bronchitis is always weak, even when these affections infringe considerably on the function of the lungs. Even under asphyxiating influences the left ventricle may sometimes become excited, together with the right, and give a sharpness to the pulse, which, combined with the arterial tension of fever, may be readily mistaken for hardness and strength. But this character is seldom permanent; and we generally find in all diseases, when the function of respiration is much impaired, that the pulse soon loses its body and strength. These considerations suggest the expediency

of examining the state of the circulation not only by the arterial pulse, but also by the pulsations of the heart itself, and by the condition of the veins and capillaries.

Under the circumstances just mentioned, when the indications of the arterial pulse are most variable and deceptive, we may often find useful signs in the condition of the *venous* and *capillary* part of the circulation. The distention of the more superficial venous trunks, especially the jugulars, in which a double pulsation often shows also the retropulsive action of an over-distended right ventricle,—the fulness of the capillaries of the lips, tongue, throat, cheeks, eyelids, nails, and other parts at first having a florid and flushed appearance, but afterwards, as the respiration becomes more injured, assuming a purple or livid hue,—are signs of great practical importance, and of a constancy more approaching to that of the physical signs. They do not, however, present themselves in the early and more tractable stages of disease; and they are always less distinct in pallid persons with small superficial vessels.

Intimately connected with the state of the circulation is the symptom of *general fever*, or *increased heat*, which attends many diseases of the chest. It depends on increased force and rapidity of the circulation, with diminished perspiration. When the perspiration is restored, the heat always falls. This exhalation of fluid not only lowers the temperature by its physical agency of evaporation, but being in itself a sign of a relaxing of the superficial vessels, it implies an abatement of the vital irritation. In the more transient forms of fever, such as the intermittent and hectic, the profuse perspiration sometimes reduces the animal heat to below the natural standard, just as the circulation is proportionately enfeebled; and the same chilling influence is illustrated by the cold sweats which succeed to temporary and irregular excitement. There are degrees of vascular irritation in which the increased heat of skin is partial, and determined by the structure of particular parts. Thus in the asthenic excitement of hectic fever, the heat is most felt in the palms of the hands and soles of the feet, because the circulation is not strong enough to drive the perspiratory excretion through the thick cuticle of those parts, which become consequently dry and hot. The same thickness of cuticle, on the other hand, when once imbued with perspiration, often keeps these parts soft and moist, when there is no sensible perspiration, on other parts. Not unfrequently the unequal state of the circulation is exhibited in febrile and inflammatory disorders by the heat of the abdomen, back, chest, or head, whilst the extremities are cooler than usual; and occasionally the same locally increased action is manifested by partial sweats, which prevent the increase of heat, and tend to reduce the excitement. We have known a patient with pleurisy perspire profusely only from the affected side, for several days; and nothing is more common, in slight abdominal inflammations, than to find the pungent heat of the belly relieved by a perspiration equally confined to that part. But we practice on the same principle, in applying to irritated or inflamed parts poultices, fomentations, and partial baths, which tend to bring the skin and superficial vessels to the same relaxed and expanded state which they have in a perspiring part.

Heat of skin, therefore, is an uncertain symptom; for it depends on a condition of the superficial circulation that is by no means constantly associated with disease of the internal organs. When present, it may as much result from a general cause—an idiopathic fever—as from a local inflammation; and cases are not uncommon in which severe, and even fatal, visceral inflammations are attended, through a great part of their course, by free perspiration; nay, the same may be said of some fevers which are called idiopathic. Still the heat and condition of the skin become valuable guides, when taken in conjunction with other signs, inasmuch as they indicate the constitutional disturbance, which is an important part of the disease, and which is sometimes as much to be considered in the treatment as the local disease which has excited it. So, likewise, when the presence of a disease has been established by other signs, the condition of the skin may prove a measure of its increase or diminution more delicate and sooner appreciable than can be found in the physical signs. Thus an increased heat of skin, coming on

during a bronchial or pulmonary inflammation, either indicates an increase of that inflammation or the addition of some abdominal or other irritation, which tends to aggravate the condition of the patient. So, too, perspiration breaking out in the hitherto dry and hot skin of a pleuritic patient, occasionally does prove *critical*, whether that word be applied to the excretion as a cause or as a sign of the amendment.

Where there is disorder of the circulation, especially of a febrile kind, we may well expect alteration of the *secretions*, which are so intimately connected with it; hence we find the urine is scanty and high-coloured, and the secretions of the liver and intestines variously deranged. As a natural consequence, too, there will be disorder of the digestive and nutritive function: the tongue will be furred, or florid: the appetite will fail; the stomach will cease to digest; thirst will torment; the blood, no longer fed with chyle, will not duly nourish the textures, nor support the functions: the strength will fail; absorption continuing active, if time permit, emaciation will ensue; and various complications of these disturbances may differently modify the character of diseases of the chest. The sensorial functions, too, may be deranged, either in consequence of the secondary visceral disturbances, or more rarely by a more direct influence of the imperfect respiration on the brain and nervous system. A knowledge of the causes of asphyxia suggests also how certain states of the nervous system may tend to develop disease of the lungs. Thus insensibility, or coma, causes imperfect respiration, and consequently congestion of the lungs; and, as we shall hereafter see, a long-continued congestion of the lungs only requires the addition of vascular reaction to convert it into inflammation. Persons rarely recover from an asphyxiated state, without suffering more or less from the injury which it leaves in the vessels of the lungs; and not a few who have been recovered from suspended animation, have sunk under the pneumonia, or bronchitis, which supervened.

We have thus rapidly glanced at some of the pathological relations of the organs of respiration to other functions, to give the reader an opportunity of considering rationally the nature and value of general symptoms. Dyspnœa, cough, pain, and signs of the circulation, with its concomitant, temperature, although often equivocal, yet when strongly marked sometimes assist us in diagnosis. It is just the reverse with the symptoms arising out of disorder of the other functions. The altered secretions of the kidneys, the liver, and the intestines, cannot inform us of the nature or presence of a disease of the chest; and still less will gastric derangement or sensorial disturbance. Not only will they not direct, but they tend essentially to blind us to the presence of pectoral disease; for they set up prominent symptoms of a new character, that may take the attention entirely from the real source of disease, and fix it on the brain, the liver, the stomach or intestines, the affections of which are only secondary, and often trivial. How often do we find peripneumony, or bronchitis, disguised by delirium or stupor, or by vomiting, a loaded tongue or diarrhœa. How often pleurisy, masked by jaundiced skin, a tender right hypochondrium, and clay-coloured fœces; or by lumbago, or nephralgia. How often tubercular consumption, obscured by sundry bilious, dyspeptic, or nervous symptoms. It will be happy for the practitioner (for his credit at least, if not always for the success of his practice) if he detect the enemy through its false colours, ere it triumph, and before the scalpel shall proclaim the delusion of his unwary mind. The physical signs will enable him to do this, and again we recommend them to the best attention of the student. On taking a rational review of the general symptoms in comparison with the physical signs, we must come to the conclusion that as diagnostic means, the general symptoms fall far short of the physical signs.

But it is not to be supposed that, because the general symptoms are often comparatively of little aid in diagnosis, we are to neglect the study of them. They are almost always of great importance in prognosis and practice. The physical signs more surely show how the pectoral organs suffer; but having discovered this, to the general symptoms we must look for how the system suffers; and as

the symptom often closely sympathizes with the injured organ, we may through them often watch the first turns of the disease before the change in the organ becomes physically appreciable. In the general symptoms we seek for those *critical* phenomena, which, although sometimes deceptive, yet generally announce the tendency of the disease to one or other mode of termination. In them we study the vital forces and properties with which nature works, and the signs of what nature can do; and in our methods of treatment these become the standards to which we direct, and by which we modify, our remedies. When we treat a patient with peripneumony or catarrh, we do not apply our remedies merely to the local lesions, inflamed vessels, or a discharging membrane; we study the system at large, we examine other functions through the general symptoms, and we direct our treatment with due reference to indications from all these several sources. We see, then, that the mere stethoscopist is but ill-fitted to practice medicine. He may justly boast of his skill in diagnosis; his place of triumph will be the dissecting-room, where he can show the lesions that he had detected; but his practice at the bed-side will be unsuccessful in proportion as local lesions vary in their general relations, and in the conditions of the constitution, or of other functions that may accompany them. The judicious physician will not omit to study the condition of the vital properties, which are exhibited in the general symptoms, as well as the local physical changes which have been already produced; and whilst he chiefly confides in the physical signs to indicate and measure the present local lesions, he carefully watches in the general symptoms the tendencies of those properties and functions which are capable of increasing or modifying these lesions, and are equally liable to be affected by them. The general symptoms being less intelligible and certain than the physical signs, need more experience to enable us to appreciate them; but we have found that even these also may be *rationally* studied, and may derive a light from a knowledge of physiology and the physical signs, which experience alone could never throw on them.

L A R Y N G I T I S.

General observations.—Two forms of Laryngitis—the Acute and the Chronic.—Symptoms of the acute.—Anatomical characters.—Diagnosis.—Causes.—Prognosis.—Treatment.—Chronic Laryngitis—its symptoms.—Anatomical characters.—Diagnosis.—Causes.—Prognosis.—Treatment.

Mucous or catarrhal inflammation not unfrequently affects the larynx, and is the cause of the hoarseness which often attends both mild and severe bronchitis. There are, however, other inflammatory affections of the larynx of a very serious and fatal tendency—those, namely, in which the inflammation affects the sub-mucous cellular membrane, and causes œdematous effusion into this tissue. The swelling which results, narrows the caliber of the larynx, particularly at the glottis, impedes the respiration, and often destroys life. To this form of inflammation the term *Laryngitis* is generally restricted. It may occur under the different forms common to other inflammations, varying according to its exciting causes, and to the state of the constitution. Dr. Cheyne has specified no fewer than nine varieties of Laryngeal inflammation, including the catarrhal form. For practical purposes, however, and for the sake of conciseness, we shall comprehend all the varieties under the *Acute* (which may be sthenic or asthenic) and the *Chronic*.

I. ACUTE LARYNGITIS.

Symptoms. The sthenic form of *acute* laryngitis often begins with symptoms of tonsillitis, with difficulty of swallowing and fever, which is generally preceded by rigours. In this case the extension of the inflammation to the larynx, or its establishment in other cases, is announced by hoarseness, a frequent husky, and sometimes convulsive cough, followed by tenderness, pain and constriction in the larynx itself, with difficult, prolonged, and sonorous inspiration, the chest being free from signs of disease. On examination the fauces generally, but not always, are red and swollen, and sometimes, by pressing the tongue forwards and downwards, the epiglottis may be seen erect, thickened, and of a bright or deep red colour. In this state the epiglottis no longer protects the glottis from the contact of matters passing into the pharynx; hence the act of swallowing not only is painful, but often causes convulsive fits of coughing, and increased difficulty of breathing. At first the fever is decidedly inflammatory; the face is flushed, the skin hot, and the pulse full and hard: but this state is soon changed under the depressing influence of the obstructed state of the respiration. A frightful train of symptoms then ensues, induced by the rapidly increasing impediment to the supply of air. The countenance becomes anxious in the extreme, and pallid; the lips livid; the eyes staring and watery; the nostrils raised; the voice is reduced to a whisper; the integuments in the fore part of the neck are sometimes œdematous; the pulse becomes quicker, feebler, and less uniform. To quote the expressive description of that experienced observer, Dr. Cheyne, "the patient is restless and apprehensive, often changing his position, in the vain hope of obtaining relief; walking, or rather staggering to and fro in great distress; feeling that he is on the point of suffocation, he cannot be ignorant of the danger to which he is exposed; hence he is willing to submit to any means of relief, and is impatient of delay. In this stage, the sufferer seldom sleeps for many minutes at a time; when he begins to doze, he starts up in a state of the utmost agitation, gasping for breath, every muscle being brought into action, which can assist respiration, now a convulsive struggle. He is quite enfeebled, becomes delirious, drowsy, and at last comatose, the circulation being more and more languid, and he dies on the fourth or fifth day of the disease, or even earlier." Death has been known to take place seven hours after the attack; in some cases it has been delayed for two or three weeks.

The asthenic form of laryngitis differs from the sthenic in the absence of symptoms of inflammatory fever, and sometimes of pain in the larynx and difficulty of deglutition. In other respects the symptoms are similar; with the same hoarseness and cough at the commencement, difficult and stridulous respiration, rapidly amounting to a feeling of strangulation, as if the upper part of the windpipe were closed, often with fits of convulsive coughing and increased difficulty of breathing, apparently of a spasmodic kind; and after inducing symptoms of partial asphyxia in one of these paroxysms, the disease may prove fatal suddenly or more gradually, by the patient after repeated attacks falling into a state of insensibility.

In one of the asthenic forms of laryngitis, the inflammatory symptoms are by no means prominent; and the affection has long been termed *œdema of the glottis*, because an effusion of serum or pus into the cellular tissue of the lips of the glottis is the destructive lesion, and few other traces of disease are found after death. In other cases, particularly those arising from erysipelas, whether propagated from other parts or at first attacking the throat and larynx, and those of laryngitis supervening on continued fever, small-pox, scarlatina and measles, the symptoms of local inflammation are more severe, pain and difficulty of swallowing are present, and after death, the epiglottis and other parts of the larynx are found inflamed and swollen by the effusion of lymph or pus into their cellular texture. The course of all these forms of laryngitis may be as rapid as that of the sthenic kind, but it is seldom so uniformly progressive, particularly in the œdematous variety, in which the attacks of difficult breathing are sudden and rather severe at

first, and may prove rapidly fatal; or they may subside for awhile after the expectoration of a little glairy mucus, and recur again with increased severity; in the interval the breathing being pretty free, but the voice still hoarse, and the sensation of a tightness or lump in the throat remaining. In the cases in which the obstruction is chiefly œdematous, it generally occupies the cellular tissue of the glottis, and from thence to the ventricles, the epiglottis being comparatively free, and there being little or no difficulty of deglutition; but in the erysipelatous cases, as in the sthenic form, the epiglottis is frequently thickened, the patient experiences difficulty and pain in swallowing, the attempt to swallow liquids sometimes causing a spasm so violent as to resemble that of hydrophobia.

Causes. Acute laryngitis may follow exposure to cold and wet. It may originate in cynanche tonsillaris, and, according to Dr. Stokes, in cynanche parotidœa, which he has found to be inflammation of the cellular membrane only, and not of the parotid gland itself. Acute inflammation of the larynx has been brought on by swallowing scalding or corrosive liquids by the convulsive action which these excite in the throat; they are in part thrown on, and even into the glottis. Children accustomed to drink from the mouth of a tea-kettle or tea-pot have often attempted to do this when these vessels contained scalding water; the result has been violent inflammation of both pharynx and larynx. Instances of this accident were first recorded by Dr. M. Hall. Mr. Porter observes, that when a person attempts to drink by mistake a corrosive liquid, a similar convulsive action takes place, closing the pharynx and throwing the offending matter violently backwards through the mouth and nostrils, under the epiglottis, and thus this accident becomes a cause of acute inflammation of the larynx. Mr. Ryland has with good reason placed the inhalation of flame or of very hot air among the causes of acute inflammatory injuries of the larynx. Persons who die from severe burns, if it be only about the head and face, generally suffer from severe dyspnœa, and the mouth and larynx are found in a highly inflamed and congested state: these effects he very rationally ascribes to the great heat of the air inhaled at the moment of the conflagration. The inhalation of very acrid vapours might possibly have the same effect. As exciting causes of asthenic laryngitis, erysipelas, scarlatina, small-pox, and measles, have been already mentioned; and we may add, that inflammation of the tongue from the excessive use of mercury, and diffusive cellular inflammation from punctured wounds, have been known to extend to the cellular tissue of the larynx and cause death. M. Bayle and Dr. Tweedie have noticed that œdematous laryngitis sometimes suddenly supervenes without any obvious cause during and after typhoid fevers. It occurs also not unfrequently in the course of chronic disease of the larynx, and is sometimes the cause of death in these cases. We have known it to come on and hazard life in a patient with aneurism of the arch of the aorta, before the tumour had well shown itself outwardly: Mr. Lawrence has adverted to similar cases.

Habitual intemperance, long courses of mercury, frequent and long-continued exertions of the voice, are supposed to predispose persons to attacks of laryngitis. Except in cases of scarlatina, measles, and small-pox, and of the accidents before alluded to, laryngitis never attacks children; and of those advanced in life, Dr. Cheyne states that it most frequently occurs in such as are liable to indigestion connected with a disordered state of the liver. In most instances, the subjects of it had previously been liable to sore throat.

Anatomical characters. The effects of laryngitis are commonly found in the red injection and thickening of the lining membrane of the larynx, and an œdematous state of the cellular tissue underneath, particularly at the upper portions, from the epiglottis to the ventricles, the parts beneath being nearly or quite free from disease. In the more sthenic cases especially, the epiglottis is very red, thickened, and erect, instead of lying over the glottis. The folds forming this chink are generally also red, and much swollen. On cutting into them, serum, or if the disease have not terminated very rapidly, a sero-purulent liquid or pus, exudes. In a few instances, lymph has been found in the cellular textures, and

in two or three there have been small patches of lymph on the glottis and under surface of the epiglottis. Rarely these parts have been found ulcerated, even in acute cases. In the erysipelatous disease, and that arising from diffusive cellular inflammation, the matter effused in the sub-mucous tissue of the epiglottis, vocal ligaments, and ventricles, is a sloughy kind of lymph with serum, sometimes mixed with pus; and the longer the case has lasted, the more purulent the liquid is. This effusion is often found to extend to the cellular texture at the root of the tongue outside the larynx, and even among the muscles of the neck and throat. In the œdematous variety the epiglottis is nearly free from disease; the mucous membrane is little injected, but the folds of the glottis are so distended, as nearly to close the orifice, and on cutting into them a clear or purulent serum flows out. It can scarcely be doubted, that in most cases this serous effusion is the result of a low form of inflammation; but it may be favoured by the existence of a dropsical diathesis, or by the pressure of a tumour on the neighbouring venous trunks: to the latter cause we would chiefly ascribe the laryngeal symptoms which occasionally show themselves in cases of aneurisms of the great vessels or other tumours at the lower part of the neck. Dr. Stokes notices the occurrence of œdema of the glottis in a patient labouring under a cancerous tumour below the jaw.

Diagnosis. The symptoms of acute laryngitis are generally sufficiently characteristic to separate it from other diseases affecting the breathing. The stridulous or hissing inspiration, heard most distinctly at the larynx, which is drawn down at each act, the seat of the sensation of pain or constriction at that part, often the visible condition of the epiglottis, and the absence of pectoral signs, suffice to distinguish it from diseases of the chest. Abscesses external to the larynx and compressing it, may cause difficulty of breathing and swallowing: sixteen years ago we saw a fatal case of this kind, which was mistaken for laryngitis, until the first incision of the throat after death gave issue to a quantity of pus which had formed among the numerous muscles of the tongue and larynx. A careful examination will generally distinguish these cases by the partial or general swelling at the upper part of the neck, often with tenderness, and an inability to open the jaw. Mr. Porter thinks that they differ from those of laryngitis in the breathing, although obstructed, being less sibilous, and more gradually oppressed, and in the diminished mobility of the larynx when pressed from side to side against the spine. We should conceive that the absence of the peculiar cough and hissing hoarseness of laryngitis might in some cases better assist the diagnosis. Spasmodic affections of the larynx may generally be distinguished by the complete absence of fever and by the suddenness of the attack; but they may not be so easily distinguished from the œdematous laryngitis supervening on chronic diseases, which is in effect generally combined with spasm: still in this case there is usually a previous slight access of fever and increase of the chronic symptoms. Spasm of the glottis is a very rare affection in adults, and occurs only in hysterical or highly nervous subjects.

Prognosis. Laryngitis has been considered by Dr. Cheyne and others to be the most fatal of all the inflammations. Of seventeen cases observed by Bayle during six years only one recovered. Of twenty-eight cases collected from various authors by Mr. Ryland, ten recovered, which he justly considers to be above the average. In most of the fatal cases, death took place between the first and fifth days. The prognosis must, therefore, in all cases be unfavourable; and the more so, as the disease has lasted longer and with progressive increase of the difficulty of breathing. When the face loses its colour or becomes livid, and the faculties obtuse, from the circulation of black blood, the danger is extreme. On the other hand, decrease of the difficulty of breathing and of swallowing, a returning freedom of expectoration, with an improved expression and colour of the countenance, give rational hopes of recovery.

Treatment. In no disease is an early and energetic use of remedial measures more essential to their success, than in *acute sthenic* laryngitis. There is a period during which free blood-letting and the administration of calomel and

antimony may arrest the inflammation before considerable effusion has taken place; but this period is very short, and has often elapsed before medical aid is resorted to; and when once the effusion has taken place, antiphlogistic measures become worse than useless, and unless artificial means of supplying air to the lungs be employed, the disease generally destroys life before there is time for ordinary curative measures, however energetic, to produce their effect. The chief indications of treatment, therefore, are,—1. To prevent effusion by reducing inflammatory action:—2. Effusion having taken place, to prevent the obstruction which it causes to respiration from producing mortal injury to the functions:—3. To promote the removal of the effused matter.

1. In endeavouring to fulfill the *first* indication by free blood-letting, we cannot do better than by quoting the directions of Dr. Cheyne. He recommends free blood-letting but not to syncope, as advised by Dr. Baillie, for this may deprive the patient of strength sufficient to struggle against the next spasmodic paroxysm of dyspnœa. “We would bleed the patient freely during the first twenty-four hours:—we should be disposed to do more: as long as the complexion of the patient is good, we would have recourse to venesection, keeping a finger on the artery while the blood flows, and closing the orifice when the pulse is reduced; we would have leeches applied or blood removed from the nucha by cupping; and we should be disposed to bleed again or even a third time, so as to abstract forty or fifty ounces of blood, and at the same time let the patient have a powder containing two or three grains of calomel, three or four of Pulv. Jacobi Verus, and one-half or one-third of a grain of opium should be taken every third or fourth hour till the gums become affected.” We would not hesitate to give double this quantity of calomel. Dr. Cheyne justly objects to blistering on account of its trifling advantages in comparison with the additional suffering which it occasions, and possible interference with the operation of bronchotomy. Perhaps the same objections would not apply to the speedy and energetic counter-irritation by the strong liquor ammoniæ, which, if applied at the side of the neck in the manner directed by Dr. J. Johnson, may produce vesication in two or three minutes. Dr. Cheyne also deprecates the use of tartar-emetic, lest it should excite vomiting, which with the erect state of the epiglottis would throw matters on the unprotected glottis, and cause a frightful convulsive irritation. For a similar reason we would object to the direct application of leeches to the tonsils, a measure proposed by Dr. Cheyne. We can testify of its utility in tonsillitis, for which it was first recommended by Mr. Crampton; but the irritation from the bites, and the blood proceeding from them, could scarcely be tolerated with an exposed glottis.

Active depletory measures employed early, may, for a time, relieve the symptoms without removing the inflammation: they often only delay the effusion, which with its resulting permanent increase of difficulty of breathing and appearance of lividity, instead of taking place in the first day, may not come on for several days. Hence the importance of attempting, from the first appearance of the disease, to fulfil the *third* indication by the free use of mercury both by calomel internally and by external inunction; for if the gums can be made sore, a secretion from the throat is established which generally reduces the swelling of the glottis. We have more confidence in the power of mercury to *cure* laryngitis than in that of blood-letting; and would consider the great utility of the latter to be in so far retarding the progress of the inflammation as to enable the mercury to act before a fatal obstruction is produced. Some few cases have yielded to bleeding alone, and its employment should never be neglected when the strength can bear it, and the conditions so well stated by Dr. Cheyne indicate it. But if the strength have already failed, or these conditions cease, and the undiminished dyspnœa and commencing lividity announce the approach of asphyxia, blood-letting becomes worse than useless, and the *second* indication by the operation of bronchotomy must then be attempted without delay. Dr. Baillie considered it advisable to resort to bronchotomy if no considerable relief be obtained from

other measures in thirty hours. Dr. Cheyne more rationally takes as a criterion the condition of the patient rather than the period; and says that if the symptoms be such as to contra-indicate bleeding and yet asphyxia is imminent, *thirty minutes'* delay may be too much: but if the complexion is good and asphyxia not threatened, the operation may be delayed *thirty days*. Surgical writers strongly urge the early performance of the operation. Louis observes, "as long as bronchotomy is considered an extreme measure (*a dernier resort*) it will be always performed too late;" and Mr. Lawrence says that it should be done, "as soon as the symptoms enable us to determine the nature of the disease." It is because we are convinced that it should be resorted to early, that we have included it in the second indication. If free bleeding produce no relief, or be not borne, and serious difficulty of breathing have become established, we would not wait for the appearance of pallor or lividity as recommended by Dr. Cheyne, and still less for the lapse of a certain number of hours as proposed by Dr. Baillie, but we would urge the performance of bronchotomy without delay. To defer the operation on account of the difficulty or danger attending it, is most unreasonable; for experience has proved that these are increased rather than diminished by delay, and the danger from the operation is at no period to be compared with the danger from the obstruction to the breathing that it is calculated to remove. Laryngitis destroys life, not by the extent or the vitality of the organ which it occupies, but by closing as it were the door of the breathing apparatus: by opening another door we render the disease comparatively trivial; and it may then be deliberately attacked by mercurial and other remedies, or if slighter, even be allowed to run its course, which commonly ends in muco-purulent secretion. When the operation has been delayed until asphyxia approaches, it will have less chance of success; but should still be tried, for a very few instances are on record where it succeeded at almost the last extremity. It is not within our province to give directions for the mode of performing the operation; but we may state that we have seen reasons for making a free incision between the thyroid and cricoid cartilages, and¹ keeping them separated for the first half hour by the thin handle of a scalpel, and afterwards by a short tube half an inch in diameter, with a projecting rim to *button* into the opening, and a ligature passing round the neck to prevent its slipping in too far. Such a tube may be made in a few minutes of a piece of hollow reed or elder stick, by winding a few turns of waxed twine around the end to be inserted, and passing the ends of the twine through the two holes bored across the outer extremities of the tube, whence they are passed and tied round the neck. The less of the tube that is introduced within the windpipe the better; for the presence of a foreign body often excites terrible paroxysms of coughing. The act of expectoration is often impossible with the opening free; it should therefore sometimes be closed after a long inspiration, that the patient may forcibly expel the accumulating matter by a full expiration through the glottis, which is sufficiently free to the exit of air: varying the posture will aid this act.

Until and after the mercurial action is established, it is often useful to apply leeches or a blister, or other counter-irritants, to the upper part of the chest; for there is a tendency to bronchitis as the laryngeal inflammation subsides; and this extension of disease has, in not a few instances, caused death where bronchotomy had saved the patient from the laryngeal affection. The treatment of the after stage of laryngitis is much the same as for the same period of bronchitis.

The great difference to be remarked in the treatment of *acute asthenic* laryngitis, whether of the œdematous or erysipelatous kind, is in the total absence of a phlogistic period in which general blood-letting may do good. Leeches freely applied to the sides of the larynx, and speedy blistering the sides and back of the neck by the strong liquor ammoniæ or acetum lyttæ, may sometimes diminish or retard the effusion until the system can be brought under the influence of mercury, which here, as well as in the sthenic form, is the only remedy to be relied on for dispersing the swelling. But if, as it more commonly happens, the progress of the disease towards causing a fatal obstruction be more rapid than the

influence of the remedies, the obvious resource will be in the early performance of bronchotomy. These cases will bear even less delay than those of the sthenic disease; for besides that they are still less under the control of remedies, they occur in weakly subjects, which are sooner injured by an obstructed state of the respiration: and it has repeatedly happened that a late operation has relieved the breathing, but the patient has sunk from the injurious influence of imperfectly arterialized blood, which had already circulated in the lungs, brain, and other organs. Hence, too, even if this influence be not immediately fatal, it may lead to secondary congestions of these organs, which in the form of asthenic bronchitis, pneumonia, or arachnitis, may ultimately endanger, and even destroy life.

In case of the secondary laryngitis, supervening in erysipelas, scarlatina, measles, typhus, and other febrile diseases, due regard must be paid to the original disease, which, according to circumstances, may require a stimulant or an opposite plan of treatment.

II. CHRONIC LARYNGITIS.

This form is of more frequent occurrence than the acute, and presents itself in a great variety of degrees. As acute laryngitis is a comparatively trivial disease as long as it is confined to the mucous membrane, and produces no swelling of the tissues beneath, so chronic inflammation may affect the internal surface of the larynx for many months, and produce little inconvenience except hoarseness, habitual husky cough, and perhaps some feeling of soreness at the top of the windpipe. This affection not unfrequently succeeds to a neglected catarrh, especially in those persons who are continually exposed to cold and wet, and are habitually intemperate; for example, hackney-coachmen and street porters. The purple faces of many such individuals give evidence of a congested condition of the capillaries, that in all probability extends to the lining membrane of the larynx; increasing its sensibility and injuring its nice adjustments in the production of the voice. This form of disease may exist long without inducing farther change, and tends rather to induce thickening of the membrane and vocal ligaments, than to end in ulceration.

It is different with the serious disease which more commonly goes by the name of *chronic laryngitis*, or *phthisis laryngea*, which, like the acute disease, reaches to the sub-mucous cellular tissue, from whence it may extend to the other constituents of the larynx, and involve them in the intractable and destructive effects which inflammation induces in these less vital textures. The chief of these are, erosion and ulceration of the mucous and sub-mucous tissues; softening, thickening, œdema, induration, contraction, and dissecting abscesses of these textures, and of the ligaments and muscles attached to them; ossification, caries, and necrosis of the cartilages; warty and fibrinous excrescences; scirrhus and tuberculous formations in the different structures. These several lesions may be variously combined, and produce disease of very different degrees of severity, those being the worst forms in which the cartilages are diseased, or extensive ulceration of the other tissues already produced. These more destructive changes may follow simple inflammation; but they are more commonly either the result of a scrofulous diathesis, and often complicated with tuberculous disease of the lungs and other parts; or they are the product of a syphilitic taint, or much more rarely of scirrhus or other malignant disease.

Symptoms. Chronic laryngitis is generally a very insidious disease, often beginning as a common catarrhal cough with hoarseness, and not attracting particular attention until it has lasted for a long time, and seriously injured the general health as well as the tissues in which it is seated. The chief symptoms are hoarseness, a husky dry cough, with soreness or pain in the larynx, felt sometimes on pressure, or rubbing it against the spine, sometimes only in the act of swallowing. Of these, the most constant sign is the change of the voice, which varies very

much in degree and kind. The dry, stridulous, or squeaking kind of hoarseness, if permanent, generally implies a worse form of disease than the deep, loose, or mucous hoarseness which may proceed more from relaxation: sudden loss of voice may occur with slight diseases affecting the thyro-artenoid ligaments, or a nervous affection of the muscles, and may not be permanent; but where a voice gradually becomes more and more cracked until it is at last lost, there is probably a progressive destruction of the vocal apparatus. In some cases the defect of the voice is perceptible only on speaking loud, or in any attempt to vary the tone; for the patients instinctively acquire the habit of speaking in that tone and degree in which the voice is best produced. Pain is so uncertain a symptom, that Trousseau and Belloc state that in more than half the cases of laryngeal phthisis which fell under their observation, there was no pain throughout the disease. There is, however, generally increased sensibility of the larynx, so that the inhalation of cold air, or any hurry of the circulation, very readily excites coughing. The cough, which in the early stages is commonly short, dry, and hacking, is described by MM. Trousseau and Belloc to assume in some instances in the later stages a very peculiar loose continuous character, like eructation or belching, which they ascribe to an inability to close the glottis, its closure being the first act of an ordinary cough. As the disease advances, there is often abundant purulent and sanious fetid expectoration, sometimes streaked with blood; but not unfrequently the sputa are scanty and chiefly mucous. The occurrence of purulent expectoration is sometimes accompanied by relief to the breathing, although the voice may suffer more, and there may be more pain or soreness in coughing; this marks the formation of an ulcer, the discharge from which diminishes the constriction of the air-passage. Instances have occurred of the expectoration of dead and ossified portions of the arytenoid and cricoid cartilages, and of calcareous concretions formed within the larynx; and in more than one case, such solid fragments have fallen back into the trachea, and caused much irritation and consequent disease in one of the large bronchi. The respiration generally becomes affected sooner or later in chronic laryngitis; the difficulty of breathing commonly coming on in the night, and on any exertion sometimes in very severe spasmodic paroxysms, leaving the patient only with a short breath in the interval. The attacks of dyspnœa afterwards increase, and prevent the patient from lying down; and in the interval, the hissing sound of the laryngeal breathing indicates some degree of permanent impediment to the passage of the air. After the orthopnœa has once commenced, death generally ensues in a fortnight or three weeks; but at an earlier period the patient may be suddenly carried off by an attack of acute œdematous inflammation of the glottis. Of nine fatal cases of œdema of the glottis, examined by MM. Trousseau and Belloc, five occurred in the course of chronic laryngitis. In many instances, chronic inflammation and ulceration of the larynx are accompanied by progressive emaciation, hectic fever, night-sweats, and other signs of phthisis, without marked dyspnœa; and the patient is ultimately worn down by cough and weakness, and is perhaps carried off by diarrhœa or some other superadded disorder. In by far the greater number of these cases, tubercles are formed within the lungs, either before or after the laryngitis begins, and become the chief cause of the decline, although too gradual in their effect to affect the breathing in a marked degree. In a few instances recorded by Trousseau, Belloc, Ryland, and others, the laryngeal lesion was uncomplicated with any pulmonary disease, the consumption having been purely laryngeal. In most of these cases the cartilages of the larynx were diseased. Chronic inflammation and ulceration of the larynx and trachea are very common with tuberculous consumption of the lungs, and are the cause of the loss of voice, and smarting or pricking sensation in the larynx, so often occurring in the advanced stages of phthisis. Ulceration was found by Louis in upwards of a fourth of the cases of phthisis noted in his work.

Causes. Chronic laryngitis may succeed to the acute disease; but it much more commonly arises from the frequent recurrence of catarrhal inflammation, particularly in those who are addicted to ardent spirits. Excessive exertions of

the voice, repressed eruptions, wounds or contusions of the throat, foreign bodies introduced into the larynx (among which may be mentioned the habitual inhalation of air loaded with dust,) and the extension of syphilitic disease from the throat, may be enumerated as occasional exciting causes. A scrofulous or tuberculous constitution particularly predisposes to laryngeal phthisis. The excessive use of mercury, habitual intemperance, and other debilitating influences, are also supposed to render persons more liable to chronic inflammation of the larynx. The disease appears to be most common at the middle period of life. According to Mr. Ryland, it affects women more frequently than men, but this is at variance with the experience of MM. Trousseau and Belloc.

Anatomical characters. We have already enumerated the principal lesions which chronic laryngitis induces. They are very various, and have been minutely described by Porter, Lawrence, Stokes, Ryland, and Trousseau and Belloc, to whose work (particularly the last) we refer for details. The simplest effect of the chronic inflammation is, 1. Redness of the mucous membrane in patches; even when not ulcerated, it has often a rough granular appearance, from the irregular enlargement of the mucous follicles. 2. Thickening of the sub-mucous tissue: this is frequently observed in the epiglottis and the lips of the glottis, causing enlargement and diminished mobility of these parts: the ventricles of the larynx are sometimes nearly obliterated from the same cause. 3. Contraction of the ligaments, wasting, induration, and fibrous degeneration of the muscles which move the cartilages of the larynx: this is a common result of chronic inflammation on fibrous and muscular textures, and must in this case impair or destroy the mechanism of the voice. Contraction, together with partial thickening affecting the epiglottis, renders it curved or corrugated, so as to defend the glottis very imperfectly. 4. Ulceration of the mucous and sub-mucous textures: this is a common result of chronic inflammation, and presents itself in great variety as to form and seat, of which the following are the most remarkable: the ulcers are sometimes small and round, but confined to the mucous membrane: in other cases they have been known to penetrate to the cartilages or ligaments; and M. Andral notices a solitary case in which one perforated the thyroid cartilage, just above the insertion of the vocal ligaments. In this case the voice was unaffected. When these ligaments are injured, the voice is generally destroyed. When again the ulcers are large and superficial, denuding but not injuring the vocal cords, there is commonly hoarseness, but not aphonia. It is between the vocal ligaments and the epiglottis that ulcers are most commonly found, but they are often met with in other parts of the larynx and trachea. They are frequently seen on the laryngeal surface of the epiglottis, and sometimes at its margin; it is only in case of syphilitic disease that the upper or lingual surface is found affected. Considerable parts of the epiglottis, as well as of the arytenoid and cricoid membranes and cartilages, have in a few instances been found destroyed by ulceration. 5. The ulceration, however, does not frequently extend to the cartilages except in young subjects. MM. Trousseau and Belloc do not consider the cartilages of the larynx sufficiently vital to take on the process of ulceration or caries. The common effect of ulceration of the adjoining textures on them is in the first place ossification, and afterwards necrosis. The cricoid and thyroid cartilages naturally become ossified in advanced life; but chronic laryngitis of two years' duration produces the same change in young persons. This is in conformity with a law well developed by Andral, that a certain degree of irritation accelerates in tissues those changes to which time would naturally bring them. The osseous matter is deposited in irregular places on the surface of the cartilage, and sometimes quite encases it. Instances of necrosis of the cricoid, arytenoid, and even of the thyroid cartilages, have been recorded by Porter, Lawrence, Cruveilhier, Ryland, and Trousseau and Belloc. The last authors state that they have found this lesion in more than half of the fatal cases of laryngeal phthisis which they have examined. In this state the cartilages are denuded of their perichondrium, and are of a dirty dull hue without their natural lustre. The sequestrum of dead

cartilage is not readily thrown off; but there is often fetid pus in the cellular texture near it. These abscesses may open and discharge their offensive contents, and even the dead portions of the cartilage, either into the larynx, or outwardly through the integuments of the neck, or into the œsophagus. It can readily be conceived how much local and constitutional irritation these dead matters may produce before they are discharged, and how in the very act of separation, acting as foreign bodies, they may produce suffocation.

Diagnosis. The most characteristic signs of chronic laryngitis are the permanent change of the voice and the peculiar cough before described, with hissing breathing and pain or tenderness in the larynx when these happen to be present. Except in syphilitic cases where the fauces are also diseased, little is to be learnt from examination of the throat; for it is impossible to see or reach farther than the epiglottis, and to get a view of this is a matter of difficulty. Neither is crepitation felt on pressing the larynx to be depended on; for, according to Trousseau and Belloc, this may be produced in a healthy larynx. Dr. Stokes describes, as a stethoscopic sign of chronic laryngitis, a harshness in the sound of the air passing through the larynx, giving the idea of a roughness of surface, perceptible even when the breathing is not distinctly stridulous. In a few cases he observed above the thyroid cartilage a rhonchus, like the sound of a valve in rapid action, combined with a deep humming. We much question that the latter sound was seated in the larynx, for such a sound is often produced in the jugular veins. When the laryngeal constriction is considerable, the peculiar sound of the passage of air through it will sufficiently distinguish it; and where it is slight or altogether absent, laryngeal disease may yet be known as the cause of the cough and other symptoms, by the negative indications of the thoracic organs, the sound of percussion and of respiration being good throughout the chest. But pulmonary tubercle is very commonly conjoined with laryngeal disease, and the two affections are apt to disguise each other. The noisy laryngeal respiration, and the absence of the voice may destroy the chief distinctive signs of phthisis in its early stages; but as the disease advances, the dulness on percussion and perhaps cavernous rhonchus in some part of the chest, particularly under a clavicle or scapular ridge, with a more copious purulent expectoration, night sweats, and more rapid emaciation, sufficiently announce this most destructive complication. When the breath and sputa in laryngeal disease are very fetid, it may be suspected that some part of the cartilages is dead. This is generally the case where a chronic abscess opens outwardly about the thyroid cartilage.

Prognosis. The milder and simple forms of chronic laryngitis are by no means incurable; in fact they generally yield to judicious treatment; and were it not for their liability to exacerbations from acute œdematous inflammation and to complications with pulmonary disease, they could hardly be called dangerous. Both these destructive complications may be apprehended when the disease has continued long, with increasing severity of symptoms of the voice and respiration, with a change of the cough from dry and ringing to loose and undivided, with increasing purulent expectoration, and particularly if the disease has resisted treatment. If from the history of the individual there be any suspicion of a scrofulous tendency, and particularly if symptoms of pulmonary disease, such as slight cough, shortness of breath, pains in the chest or shoulders, quickened pulse, &c., preceded those of the laryngeal affection, the prognosis is unfavourable; and if there are found any physical signs of phthisis, such as dulness under a clavicle, the case of the patient must be considered almost hopeless. Fœtor of the breath and sputa, implying mortification of the cartilages, is also very unfavourable; but it is more probable that the dead portions of these may be thrown off, than that tuberculous disease of the lung combined with a laryngeal lesion may be cured. In all doubtful cases, particularly those of a syphilitic origin, the state of the general health and strength, as well as the degree of the local affection, must be duly taken into account in estimating the probable issue of the case.

Treatment. The curative indications are, 1. To subdue the chronic inflam-

mation and to promote the removal, as far as possible, of its effects on the structure; 2. To relieve urgent symptoms as they arise; 3. To improve the condition of the general health.

1. It is necessary to premise, that as a condition essential to the success of any mode of treatment, the diseased parts must be kept as much as possible in a state of rest by suspending the exercise of the voice, which is the work of the larynx; and to effect this it is sufficient to limit the patient to speak in a whisper only, which exerts the larynx no more than respiration does. This restriction is a more practicable one than that to absolute silence. The protection of the parts from the irritating influence of cold air, smoke, dust, &c., is also very necessary. This may sometimes be effected by means of a respirator, without confining the patient to warm rooms. As is generally the case in chronic inflammations, general blood-letting is useful only to relieve temporary congestions, or in plethoric subjects to prepare for the better action of other remedies. Local bleeding, especially by leeches, is more frequently beneficial, particularly in case of temporary increase of the local symptoms, when the cough is more troublesome than usual, with pain or increased tenderness in the larynx. They should be applied to the sides of the larynx or under it; and if they give relief they may sometimes with advantage be repeated in small numbers, every two or three days for some length of time. In a greater number of instances, however, more benefit will be derived from continued counter-irritation at the sides of the neck or upper part of the chest; and for this purpose the tartar-emetic solution or ointment, or a caustic issue, or well-managed seton, will answer better than blisters. A succession of pustular eruptions, or a discharge of pus from beneath the cutis, has an influence over an established chronic inflammation of a sub-mucous tissue far greater than serous discharges.

To modify the action of the diseased textures, and to promote the absorption of the solid matter effused in them, no measure has been found so efficacious as a mild mercurial course, varied to the extent of affecting the gums. Unlike in the acute disease, there is time enough to produce this effect without giving very large doses; and as soon as it takes place, there is generally a diminution of the pain and constriction in the larynx, improvement of the voice, and a loosening of the cough. If the disease be not of long standing, and there be no extensive ulceration, or disease of the cartilages, the means already named will often effect a cure. But where the disease has lasted long and induced considerable local lesions and constitutional derangement, other measures, both local and general, should be employed. In cases where the influence of mercury might be hurtful, as in those of a strumous diathesis, a course of hydriodate of potash with an excess of alkali will sometimes prove very beneficial. The inhalation of steam, in some cases rendered slightly stimulant and alterative by the addition of camphor, turpentine, or a balsam, has been found useful in promoting the secretion of the diseased membrane. MM. Trousseau and Belloc place much confidence in medicaments applied directly to the diseased part, and some of those which they recommend are of a very energetic kind, such as nitrate of silver, corrosive sublimate, sulphate of copper, &c. They may be applied either in solution or in powder. The solution which they have found most effectual is that of nitrate of silver in the large proportion of from one to two parts in four parts of distilled water. This solution may be applied to and behind the epiglottis, by a small roll of paper bent at its moistened end. A more effectual mode is with a small round piece of sponge, fixed to a long rod of whalebone bent, at an inch from the sponge, to an angle of eighty degrees. The patient's mouth being opened wide, and the tongue pressed down with a spoon, the sponge is passed to the top of the pharynx; as soon as it reaches the fauces, a movement of deglutition takes place which carries the larynx upwards, at which moment the sponge is brought forward and squeezed under the epiglottis, and the solution freely enters the larynx. Convulsive cough and sometimes vomiting ensue; but the application causes no pain. A less disagreeable mode of applying the solution is by a small silver syringe, filled one-fourth

with the solution and three-fourths with air. To this is affixed a tube five inches long, bent at the free end, which being carried beyond the epiglottis, the syringe is forcibly discharged, and in consequence of the air in it throws the solution not in one stream but in a fine shower, part of which enters the larynx. The patient is then made to rinse his mouth with and swallow salt water, or water acidulated with muriatic acid, which decomposes the remains of the nitrate; the same precaution should be used where this agent is applied in substance. MM. Trousseau and Belloc found this application (which they term cauterization) highly beneficial in several cases of chronic laryngitis. In cases of aphonia, probably dependent on relaxation rather than inflammation, it effected a cure in a few days; in some worse forms of the disease, with probably ulceration of three or four years' standing, its repeated application during five or six weeks was successful; and it produced considerable temporary improvement in three cases which proved afterwards to be tuberculous. Solid substances may be applied to the larynx in powder by insufflation, as recommended by Aretæus for angina maligna. The powder is put into one end of a reed or glass tube, and the other is carried back as far as possible into the mouth: after a full expiration the patient closes his lips around the tube, and inspires suddenly and forcibly through it, by which some of the powder is carried into the larynx and trachea. The cough which is excited should be restrained as much as possible, to prevent the too speedy expulsion of the medicine. The powders used by MM. Trousseau and Belloc are sub-nitrate of bismuth, which may be used pure with safety and advantage in most forms of chronic laryngitis, even that accompanying phthisis; calomel with twelve times its weight of sugar; red precipitate, sulphate of zinc, and sulphate of copper, each of which must be mixed with thirty-six times its weight of sugar; alum with twice its weight, and acetate of lead with seven times its weight of sugar; and nitrate of silver with twenty-two, thirty-six, or seventy-two times its weight of sugar. The last is said to be most effectual in erythematous laryngitis with erosions or ulcerations. Calomel and red precipitate have proved beneficial in ulcerations, whether syphilitic or not, but they should not at first be repeated oftener than twice or thrice a-week. The others may be used twice or oftener daily, according to the nature of the case. The powders should be impalpably fine; the least roughness or perceptible fragment of a crystal excites such efforts to cough as ensure the expulsion of the powder. This description of the treatment of MM. Trousseau and Belloc is taken from an abstract in the *British and Foreign Medical Review* by the writer, and appears to be well-worthy of the attention of British practitioners, in proving the safe direct application of powerful agents, which as in external diseases are likely to improve the action of the diseased parts.

2. The second indication—to relieve urgent symptoms, especially requires attention, when the attacks of difficult breathing or of cough are very urgent. These arise in some degree from spasm, and may often be relieved by sedatives and antispasmodics, such as belladonna, camphor, ether, and opium, both taken internally and applied by inhalation in the steam of hot water. Drs. Graves and Stokes recommended particularly the use of a belladonna plaster to the external throat, and a hot pediluvium. If, however, the more gradual supervention of the dyspnoea, with feelings of increased uneasiness in the larynx, and perhaps some fever indicate that the aggravation of the symptoms is produced by an attack of œdematous inflammation, and this be not speedily relieved by leeching, it may be necessary to adopt the surgical means of relief recommended for that affection, avoiding dangerous delay after the character of the attack has been clearly made out.

3. The third indication—to improve the condition of the general health, is in many cases a point of the first importance; and until it be fulfilled, any other measures may be of no avail. No particular rules can be laid down for this purpose; but the practitioner may well be guided by the state of the constitutional symptoms. To preserve a due balance of the secretions, to improve the nutrient functions by a well-regulated mode of diet and regimen, aided by mild alterative

tonic, such as sarsaparilla and saline chalybeate waters, and especially to assist both nature and art by placing the patient in a salubrious and congenial climate, are the objects chiefly to be aimed at, in order to fulfil this indication. When the disease has a venereal origin, a proper course of mercury will generally be indicated; but this will often fail, unless measures be at the same time taken to improve the general health; and if this have already suffered much from mercury in repeated or ill-directed courses, or in a strumous habit, it will be necessary, for the time at least, to use the iodide of potassium and other general measures, with whatever local treatment the nature of the case may admit. In such cases, fumigation of the fauces with cinnabar (sublimed from a hot plate, or a laundry iron) will sometimes improve the character of the local disease.

Chronic laryngitis is interesting on account of its relation to pulmonary phthisis. It is connected with it in three different ways:—1st. It is a cause of phthisis if accidentally developed in healthy individuals; that is, if the chronic laryngitis continue very long, tubercles are generally developed in the lungs, and proves the cause of death. 2d. It may occur nearly at the same time with the deposit of tubercles in the lungs, or a little before, in persons of a serofulous constitution and already strongly predisposed to phthisis. 3d. The laryngitis occurs as a mere secondary lesion, long after phthisis has set in. The last variety is strictly a consequence of the disease of the lungs, and is in itself of little moment. The other varieties are so far important that they should always excite the attention of the physician, and induce him to be guarded in his prognosis: as many of these cases of laryngitis terminate in consumption of the lungs, although for a long time no local evidence of phthisis should be present. Should phthisis not supervene, chronic laryngitis is still a serious affection, and in not a few instances terminates fatally, but there is always a much greater chance of recovery than if complicated with phthisis. Chronic laryngitis not followed by phthisis is generally of the syphilitic variety, and, therefore, more curable, unless the cartilages be destroyed, or its usual sequel,—phthisis supervenes.

G.

TRACHEITIS, OR CROUP.

Symptoms of its various forms.—Anatomical characters.—NATURAL HISTORY.—Diagnosis.—Causes —
Prognosis.—Treatment.

THIS disease has been described under a variety of names: *Tracheitis*; *croup*; *cynanche vel angina trachealis*; *cynanche stridula infantum*; *angina polyposa membranacea vel exudatoria*; *tracheitis infantum*, &c. Its essential pathological character is inflammation of the trachea, attended by swelling of the tissues, and often by the exudation of a concrete albuminous membrane, which, by the spasmodic contractions which its presence excites in the windpipe, occasions difficult and stridulous breathing. This disease, so serious and destructive in early life, has been the subject of several able treatises; and although its existence was scarcely recognised till the middle of the last century, it is now as well understood as other diseases of the air-passages. In the history of the usual form and progress of the disease, we shall often avail ourselves of the descriptions given by the latest writers, Dr. Cheyne and Dr. Copland.

Symptoms. For practical purposes rather than because they are in an obvious degree so presented in nature, it is useful to divide the symptoms into, 1. Those of the invasion; 2. Those of the developed stage; and 3. Those of the collapsed or suffocative stage.

1. The first symptoms of an attack of croup are by no means distinctive; they are commonly of a catarrhal kind, but with more fever, perhaps a more hard hol-

low cough, with alternate chills and heats and flushing, a loaded tongue, hoarseness, heaviness of the eyes, fretfulness, restlessness at night, and sometimes a manifestation of uneasiness in the throat, by the child frequently putting the hand to it. The presence of bronchial inflammation at this time is shown by the sonorous and sibilant rhonchi heard in many parts of the chest; but the tracheal breathing is not yet stridulous.

2. The developed stage of the disease is manifested by stridulous inspiration, which is like a sonorous or sibilant rhonchus, only much louder; it can be heard through the stethoscope or ear applied to the neck, before it is otherwise distinct; the cough is of a peculiar rough barking or ringing kind, followed by an inspiration more hissing and sonorous than usual: hence the combination of the cough and inspiration has been compared to the barking of a puppy or the crowing of a young cock: the voice becomes decidedly hoarse: the pulse is frequent and hard: the carotids beat strongly, and the pulsations of the heart are heard all over the chest; the skin is hot; the face flushed; the eyes watery and injected; the head thrown back; and the child is extremely restless and indicates pain or uneasiness about the trachea and larynx, which is often slightly swollen externally, and tender to the touch. These symptoms generally come on at night, and may somewhat subside in the morning; but the quickness of pulse, stridulous breathing, and hoarseness continue. The remission may last until the evening, or until the patient falls asleep, when the symptoms soon return, and become more severe than ever; the difficulty of breathing, with its accompanying distress, being increased. The cough is more harassing and convulsive, and threatens suffocation; the respiratory muscles are thrown into their fullest action; and whilst the whistling inspiration shows the constriction of the upper portion of the air-passages, the indistinctness of the respiratory murmur in the chest, and the concave state of the intercostal spaces at each inspiration, show how little air enters the chest. All these symptoms become more and more urgent, particularly the state of the breathing and the cough, which now sometimes ends in vomiting or in the expectoration of viscid phlegm, occasionally streaked with blood, or containing shreds of opaque albuminous matter, and, in rare cases, a tubular mould of the trachea formed of this matter, like a piece of softened macaroni. The voice, too, by this time has become changed to a hoarse whining note, and afterwards is suppressed; the pulse becomes excessively frequent, and sharper and smaller; the face and neck become more swollen, and either purple or pallid, especially during the fits of coughing. During the intervals, the child remains in a half stupid state, the whole strength being given to the act of respiration. The disease may reach the acme of this stage within twenty-four hours, in rapid cases; but in those of slower progress, in which there have been several remissions, perhaps following the expectoration of the viscid or albuminous exudation before noticed, this stage may be protracted through several days; and, in favourable cases, terminate in recovery without passing to the third stage.

3. The third or collapsed stage is marked by a general failure of the vital powers, the difficulty of breathing being undiminished. The pulse becomes extremely weak, thready, and irregular; the cough more suppressed; the voice gone; the face swollen and pallid, or with the lips slightly livid; the neck full, the superficial veins distended, the skin cold and perspiring, and the efforts of the poor little sufferer to get breath are most painful to behold; they become weaker and weaker, and at last cease; or, in the case of infants, they are sometimes cut short by a fatal convulsion. From this stage, recovery can take place only in the rare event of free expectoration of the albuminous exudation. The noisy state of the tracheal breathing renders it difficult to investigate the state of the chest; but there may sometimes be heard, especially after coughing, a general mucous rhonchus throughout the lungs; and, in some instances, the chest becomes partially dull on percussion.

Such is the common course of croup in its severe forms: but as in the case of other inflammations, the disease may vary in intensity; and, instead of being

precisely of the character described, it may exhibit sthenic, asthenic, and catarrhal varieties in regard to the fever and inflammation; and it may be more or less complicated with a spasmodic tendency.

The sthenic form attacks plethoric and robust subjects, with high fever, strong pulse, hard cough, pain in the larynx, with little or no remission in the stridulous constricted breathing; and, unless very promptly treated, passes into the stage of collapse, and proves fatal in from twelve hours to five or six days.

The asthenic form occurs in debilitated or cachectic subjects, especially those reduced by previous disease: the fever is low, and the progress of the disease more tardy; but the stage of collapse supervenes early, if the disease be severe. The albuminous exudation often extends to the throat and fauces, and is then identified with the *Diphtheritis* of Bretonneau, especially in the asthenic form of croup, which occasionally comes on in connexion with scarlatina and cynanche tonsillaris.

The catarrhal variety of croup is by no means uncommon, and forms the link between the plastic and mucous inflammations. It is attended with much cough, and various rhonchi in the chest, and, from the extent of the inflammation, is often of a very serious character, its favourable issue depending on the free expectoration of tenacious bronchitic mucus. Like both croup and bronchitis in children, it is liable to remissions and exacerbations, dependent partly on the subsidence or increase of the inflammatory swelling, and afterwards of the secretion within the air-tubes, and partly on temporary spasmodic constriction induced in the upper portions. This form of croup may supervene on ordinary bronchitis, adding to its symptoms the stridulous inspiration and ringing cough indicative of the constriction of the trachea and larynx. The addition of croupy symptoms to bronchitis, or of general bronchial inflammation to croup, must be considered a serious aggravation of the simple disease.

The spasmodic form of inflammatory croup is that which, occurring in irritable children of a nervous temperament, and disposed to nervous affections, presents a preponderance of spasm in the constriction causing the difficult breathing: hence the attacks are more sudden, and may be very severe; but they are succeeded by more complete remissions than in the purely inflammatory form. There may be every degree of combination of the nervous with inflammatory symptoms; the most inflammatory kind of croup is not free from some admixture of spasm, particularly in its advanced stages; and the asthenic and catarrhal varieties generally evince, by the sudden character of the exacerbations and remissions of difficult breathing, that the muscles of the larynx and trachea are thrown into a temporary spasm. But there are cases in which there are few inflammatory symptoms; and the more nervous the subject, the more readily may even slight bronchial and tracheal inflammation excite this spasm. So it may happen, too, that mere nervous irritations, such as from teething, disordered bowels, worms, &c., may, without any inflammation, cause spasmodic constriction of the windpipe, and thus imitate croup; this is the true *spasmodic* croup, which will be noticed hereafter.

Anatomical characters. On examining fatal cases of croup, there are generally found a variety of lesions in the respiratory organs, indicating the effects of different degrees of inflammatory action. In the instances in which death has occurred early, the mucous membrane of the trachea, and generally of the larynx and bronchi, is found to exhibit bright vascular redness, continuous or in patches; and it is often covered with a viscid mucus, sometimes tinged with blood. The sub-mucous tissue between the rings of the trachea, and in the looser parts of the larynx, is often much swelled: at a more advanced stage, is mixed with an opaque yellowish or gray-white albuminous matter, in films or patches, often tinged with blood, adhering to the mucous membrane; and in the sthenic cases that have run their full course, this is of such abundance and consistence as to form a false membrane or a tubular mould of the trachea, in some instances extending to the larynx or bronchi. This is obviously the product of the inflamed

membrane; and it is remarkable that in the most sthenic cases, or purely inflammatory croup, it is usually thickest and most consistent, but confined to the trachea; whereas, in asthenic cases it is thin, loose, and often extends to the bronchi. In some of the severest and most speedily fatal cases, the albuminous matter is found in a semi-fluid state intermediate between lymph and pus; and this matter has been sometimes expectorated when the disease has not proved fatal. The membrane is neither so red nor so much swelled as in the earlier stage, before the albuminous effusion has taken place. In catarrhal croup this effusion is in smaller quantity, and mixed with an abundant viscid mucus. In the more spasmodic forms, a false membrane or opaque exudation is seldom found, but merely viscid mucus covering patches of vascular redness, especially in the larynx. In most instances that have lasted for some days, and in all of the catarrhal variety, the bronchi exhibit the marks of acute bronchitis, and contain much viscid mucus. Sometimes, too, in such cases, portions of the lung have been found in the state of inflammatory engorgement and hepatisation; and signs of inflammation are now and then seen in the pleura. Interlobular and sub-pleural emphysema are also occasionally met with.

Nature. The nature of croup has been the subject of much discussion. In Dr. Copland's *Dictionary*, the reader will find an account of the various opinions which have been held respecting it. Our limits do not permit us to enter into these; and we shall only give that view which, in the present state of our knowledge, seems most tenable, and which best comports with the whole history of the disease and the effects of remedies on it. These indubitably prove true croup to be essentially an inflammatory disease of the air-passages, especially of the trachea and larynx. But why does it differ from the catarrhal or bronchitic inflammations which we find to occur in the same parts? Many authors seem to consider its seat to be the same as that of catarrhal inflammation, and that the difference of its product (lymph instead of mucus) is to be ascribed to the early age at which it most frequently occurs. But this is insufficient; for, at the same age, we meet with bronchitis affecting every portion of the air-tubes, yet without constituting croup. Others again, and among them Dr. Copland, refer the peculiarity of the product to an excess of albumen in the blood; but even this, although it probably has a share in determining the amount of membranous or other solid formations within the air-tubes, does not alone seem sufficient to cause it; nor can it be ascribed to the intensity of the inflammation; for although the albuminous effusion is generally thickest and most tough in sthenic cases of croup, yet it is pretty abundant in asthenic cases; so much so, that Andral and Gendrin consider plastic inflammations of mucous membranes to be rather of the sub-acute than of the most acute kind. To say that the inflammation is one of a specific character, throws no light on its nature. But does not the pathological and anatomical history of croup seem to point out that the seat of its inflammation is deeper than that of bronchitis? The distinct and circumscribed position of the inflammation and painful constriction in the most marked cases; its fixedness in this part, not wandering or creeping about, as catarrhal inflammation does; the tenderness, and sometimes the swelling of the trachea and larynx externally; the nature of the product of the inflammation, which is coagulable lymph, as from serous or cellular membrane, the thickened state of the sub-mucous texture found after death in the earliest stages, and the tendency of this texture to suppurate in chronic cases, where the subject approaches adult age,—seem to render it probable, that the inflammation owes its peculiar character and results to its being more deeply seated, more of a phlegmonous character than mucous inflammations, and involving essentially the sub-mucous cellular tissue. This view has not been generally held; Mr. Ryland alone distinctly inclines to it, when he remarks, that “the inflammation of croup appears in the first instance chiefly to effect the cellular tissue that enters into the composition of the mucous membrane, and not the muciparous follicles themselves; and the albuminous exudation is poured out by the secernent arteries of the cellular structure.” Dr. Stokes remarks, that no

satisfactory explanation of the greater frequency of croup in the infant has been given; and he seeks to account for it by the general fact of the predominance in the young subject of white tissues, which reproduce their kind. This idea may lead to an explanation, but it does not set it forth; and it leaves still a mystery why croup differs from bronchitis in the same subject. But if we examine the air-tubes of young subjects, we find in them, as in other parts, an abundance of the fine sub-mucous cellular tissue, whilst the mucous membrane is more fine and less complex than it becomes in after life, when, from the continued irritations to which it has been exposed, its follicular apparatus attains its full activity and development. The blood, too, in the young subject, abounds with the plastic material of nutrition, which is more abundantly thrown out under the influence of inflammation, than in the adult. Yet, as long as the inflammation, even in young subjects, is confined to the mucous membrane, the disease is simply catarrhal or bronchitic, and its product mucous or purulent. But the inflammation may readily reach the active and vascular sub-mucous tissue, and then it has the more fixed character of the inflammation of croup, the product of which easily transudes through the fine mucous membrane; and, as in the analogous case of serous inflammations, which are also seated chiefly in the sub-serous tissue, the product is coagulable lymph. In adults, where the mucous membrane is more developed, and the sub-mucous tissue less so, inflammation is less likely to reach the latter: when it does, it attacks the looser parts of the larynx, and, modified by the active mucous secretion, its product is pus instead of lymph; or it may be confined to the tissue, and cause the œdema, thickening, or purulent infiltration of laryngitis.

The pathological history of croup is quite intelligible. The inflammation may commence at first in the sub-mucous tissue, or it may have been first catarrhal, in which very common case, catarrhal symptoms precede those of croup. The inflammation immediately causes increased sensibility of the contractile fibres, and interstitial effusion in the lining of the trachea and larynx: hence results the constriction, partly spasmodic, partly from swelling of the air-tubes; and hence the croupy inspiration and cough, and the hoarseness. Afterwards lymph is poured out in a liquid state, and becoming concrete, forms the false membrane, another cause of obstruction to the passage of the air, both directly by its bulk, and also by the spasmodic contraction which its presence causes in the muscular fibres of the tube. The latter cause acts especially when the false membrane reaches to the larynx, and excites its very irritable muscles; in such cases, the paroxysms of dyspnœa and cough are frightfully severe and suffocating. The share which spasm has in causing the dyspnœa may be inferred from the fact, that in no case have the air-passages been found so much blocked by the albuminous secretion as to account for the amount of the obstruction; and in many cases the constriction has appeared greatest, where little or no exudation was found after death. It must not be forgotten, however, that œdematous swelling, like that of erysipelas, may disappear after death. The separation of the concrete matter from the tube, and the prevention of its becoming permanently adherent and organized, is doubtless owing to the mucous secretion and the continued motions of the tube. In cases where the albuminous effusion is less plastic, or the follicular mucous secretion more abundant, the matter may be liquid and purulent; and this generally takes place in the bronchitic variety. The collapse which takes place towards the fatal termination of croup is, like that in bronchitis, to be ascribed to the imperfect state of the function of respiration, and the consequent injurious effect on the vital powers. The lividity, coldness, occasional attacks of convulsions, &c., are the result of the circulation or stagnation of imperfectly oxygenated blood. From the same cause arises, also, the congestions in the lung, which may in parts take on the irritation of inflammation and become hepatized. The emphysema occasionally detected in the lungs, is plainly produced by the violent efforts of breathing.

Diagnosis. The very peculiar sound of the breathing and cough, and altered voice, are generally sufficient to distinguish croup from other diseases; and it is

important to know that the stridulous inspiration may often be detected through the stethoscope applied to the trachea, before it is otherwise distinct. A ringing cough, like that of croup, is often present during the early stage of measles, before the eruption has come out, but it soon becomes catarrhal, and is unattended by the croupy inspiration. In the advanced stages of croup, when the respiration is become so feeble as to lose much of its peculiar character, it may be more difficult to determine whether the obstruction be in the windpipe or in the chest; but then the comparatively good sound on percussion of the chest, and the concave state of the intercostal spaces at each forcible inspiration, showing that there is room in the chest for the air if it could find its way in, will generally suffice to distinguish croup from diseases of the chest. Such diseases being, however, a common concomitant of croup, the existence of the signs of bronchitis or pneumonia does not disprove the existence of croup. The loud sound of the tracheal breathing of croup may in great measure obscure any signs of disease within the chest; but, as Dr. Stokes has remarked, this is seldom the case constantly, particularly at the early stage of the affection, or after the act of vomiting, when, the tracheal sound being less, the sonorous and mucous rhonchi of bronchitis, and the crepitation of pneumonia, would be heard if they were present. From spasm of the glottis, or purely spasmodic croup, and hysterical affections simulating it, inflammatory croup may be distinguished by the presence of febrile symptoms, the less sudden and more permanent character of its attack, and other points in its history.

Causes. Exposure to cold and damp is supposed to be one of the most common exciting causes of croup. It prevails most generally in cold climates, especially in damp situations exposed to the east. In England, it is a far more common disease near the eastern than the western coast. Nothing is more apt to bring on croup in children predisposed to it, than exposure to a keen east or north-east wind. This wind is remarkable for its dryness; and we are inclined to think that the influence which damp situations seem to have in favouring its occurrence, is that of a predisposing rather than of an exciting cause. There can be little doubt that residence in low, humid, and ill-ventilated places gives to children an increased susceptibility to the influence of cold and other morbid causes; so that this and other inflammatory diseases may be more readily excited in them. Hence it prevails in the clay-bottomed valleys of chalky districts; in the more exposed parts of fenny countries; in some of the deep valleys of Switzerland, through which, low and damp as they are, the cutting winds from the snow mountains sweep in great severity. As it may, from these causes, be endemic in particular situations; so, from the prevalence of cold east winds, particularly after relaxing damp weather, it may be epidemic at particular seasons.

The ages at which croup most commonly occurs, are from one to six years; it is rarely met with before and after these ages. There are very few cases on record, of true inflammatory croup in the adult. Diphtheritic affections, on the other hand, frequently occur in mature age. We have before mentioned that croup may supervene as a sequel or concomitant of other diseases, such as bronchitis, measles, scarlatina, small-pox, &c. It also comes on from too early exposure during convalescence from febrile disorders. In some families there is a strong predisposition to croup; which fact is not more extraordinary than analogous tendencies to catarrh, quinsy, &c.; and its inflammatory or spasmodic character depends on the prevalence of the phlogistic or nervous diathesis, which may attach to families as well as to individuals.

Prognosis. Croup is a most serious disease: if not arrested by treatment, it generally leads to a fatal termination, and it often baffles the most active measures. According to the statements of M. Double, the mortality in the present day is nearly one-half of the whole numbers attacked: formerly, when the treatment of the disease was less understood, it amounted to nearly four-fifths. Whenever, therefore, the disease has declared itself by the croupy inspiration and difficult breathing, the patient is to be considered in great danger; and this danger is increased in proportion to the time during which the breathing continues to be op-

pressed. The supervention of convulsive paroxysms of cough, also, brings the patient into immediate jeopardy, either of sudden suffocation or convulsions, or of speedy and often fatal collapse. The proportionally small size of the larynx in children, compared with adults, no doubt adds, as Dr. Copland remarks, to the danger of the disease; but we cannot admit that it is a predisposing cause, as Dr. Cheyne has supposed. In the confirmed stage of croup, the chief hope is in the removal of the albuminous exudation by coughing and vomiting, or by the free expectoration of muco-purulent secretion. The vital forces are not often sufficient to accomplish this; but cases have occurred, in which by these means children have been snatched from the jaws of death, and recovered speedily or slowly according to the bodily strength and the freedom of the organs of respiration from remaining disease. The coexistence of bronchial or pulmonic inflammation much increases the danger of severe croup; but it does not render the case quite hopeless; and the slighter attacks of croupy inflammation supervening on bronchial inflammation, are less dangerous than the severe forms of the simple disease.

Treatment. The curative indications in croup are well stated by Dr. Copland. 1. To diminish inflammatory and febrile action when present, and to prevent, in these cases, the formation of a false membrane, or the accumulation of albuminous matters in the air-passages: 2. When the time for attempting this has passed, or when it cannot be attained, to procure the discharge of these matters: 3. To subdue spasmodic symptoms as soon as they appear: and, 4. To support the powers of life in the latter stages, so as to prevent the recurrence of the spasms, and to enable the system to throw off the matters exuded in the trachea. (*Dict. of Pract. Med.*)

If the disease is in its earliest stage, described as that of invasion, the first indication should be pursued with promptitude and energy. An emetic of tartarized antimony or ipecacuanha is the first and best remedy in all cases; and in the slighter ones it may cut short the disease, especially if followed by a warm bath and a dose of calomel and James's powder, repeated every two or three hours, and carried off, if necessary, by a dose of castor oil. In general, however, the relief is not complete, and the pulse becomes harder and the countenance more flushed after the operation of the emetic. If there be considerable fever, and the other symptoms of the invasion be pronounced, it is proper at once to resort to blood-letting with as much freedom as the strength of the patient will bear. Dr. Cheyne recommends venesection to be practised (in the jugular vein of very young children) ten minutes after the exhibition of the emetic: by this mode, the loss of a few ounces of blood induces vomiting followed by faintness, which lasts for some time, a powerful impression being made at a small expense of blood. For severe cases he advises a repetition of the bleeding in two or three hours; and leeches, if necessary, afterwards,—avoiding their application to the larynx, because, in case of excessive bleeding, pressure cannot well be applied there. Dr. Copland thinks that, for town practice, blood-letting by cupping between the shoulders or to the nape of the neck, or leeches to the top of the sternum, is preferable to venesection; and he states that the loss of little more than an ounce or an ounce and a half of blood for each year of the patient's age can well be borne, whilst the nausea from the emetic continues. M. Guersent recommends the bleeding before the emetic, for which he prefers ipecacuanha. As it appears to be a great object to reduce the inflammatory action without an excessive loss of blood, and as blood-letting alone is rarely sufficient to cure croup, the plan recommended by Dr. Cheyne is to be preferred; but we think with Dr. Copland, Goelis, and other writers, that local bleeding will generally be sufficient in young children, and all that are not plethoric.

In the second stage, when the symptoms are fully developed, and the stridulous dyspnoea permanent, blood-letting is less effectual, and not so well borne: it can, therefore, only be used at the earlier period of this stage, and then with caution: the albuminous effusion having then taken place, which blood-letting will not remove, our endeavours must be also directed to fulfil the second and

third indications; and these are, in the first instance, still best pursued by remedies called antiphlogistic. Of these, the most powerful are antimonial and mercurial medicines. Dr. Cheyne first recommended tartar emetic in 1801; and stated, in 1832, that he had found no other remedy worthy of confidence in the second stage of croup. The dose is from a quarter of a grain to half a grain repeated every half hour or hour, until it induce sickness; and then hourly whilst the inflammatory symptoms continue, as long as the strength of the patient will admit. Dr. Stokes and Mr. Porter follow Dr. Cheyne in recommending this remedy as the chief one in croup: the former places it above blood-letting.

The late Professor Hamilton of Edinburgh, J. P. Frank, Michaelis, and others, depend chiefly on calomel in large doses, as first recommended by Dr. Rush of Philadelphia. The long and extensive experience of the former physician at Edinburgh, where the disease prevails much, entitles his advice to our attention. He recommends large doses to be given and repeated at intervals of one or two hours, until they cause dark green stools: a very large quantity is sometimes required to produce this effect, relief generally ensuing on their appearance, but not before. The remedy thus given, sometimes causes great exhaustion, which is to be counteracted by wine or other stimulants. After venesection and an emetic in the first instance, Dr. Hamilton places implicit confidence in calomel, which he considers to have a specific operation, and not that of a purgative or derivative merely. We have found this remedy a most valuable one, especially in the less sthenic and more spasmodic form of the disease; but we do not consider its operation to be different from that in other diseases of children, such as pneumonia and hydrocephalus, in which, as soon as it affects the system, it causes copious spinach-like evacuations. It probably acts both by derivation and by diminishing the albuminous contents of the blood, as well as by the peculiar alterative or sorbefacient operation which it exerts in inflammatory diseases, when it affects the system, and which is visible in the case of *iritis*. In all severe inflammatory cases we confide in tartar emetic and calomel used conjointly, rather than on either separately. The tartar emetic may be given in the manner recommended by Dr. Cheyne, taking care to watch in very young children against the symptoms of sudden depression that sometimes come on during its use. The calomel is best given in large doses, once, twice, or thrice in the day, so that it may act freely on the bowels. From two to four grains for children below the age of two years, and from four to twelve grains above that age, according to the strength of the subject, and the violence of the inflammation, are more effectual than smaller doses more frequently repeated. If the bowels are irritable a minute quantity of opium in Dover's powder, or in the *Pulvis Opiatus*, should be added; and if there has been diarrhœa, the *Hydrargyrum cum Cretâ* in double quantity may be substituted for the calomel, but is much inferior in antiphlogistic power.

Blisters have been generally recommended immediately after blood-letting; but their application requires caution, particularly in very young subjects, in whom they are apt to cause sloughing. In such cases, silver paper or gauze moistened with oil should be placed between the blister and the skin, and the blister should not be left on for more than three or four hours. The nape or side of the neck is the best place for applying them, and not the throat, for this is too near the inflamed part. In consideration of the deep-seated character of the inflammation, we should anticipate a more effectual result from counter-irritation by tartar emetic, which has a deeper and more permanent operation than blisters. The sides of the neck should be rubbed downwards with a brush or coarse flannel until they are red, and then with a sponge or flannel dipped in a saturated solution of tartar emetic for five or ten minutes: this leaves a vivid erythema, which in the course of a few hours forms a great number of small pustules, which discharge a seropurulent fluid for several days. A more speedy mode of counter-irritation, and one well suited to the spasmodic variety of croup, might probably be found in that by strong liquid ammonia, in the manner described by Dr. Johnson: he found that, by two minutes' application of lint moistened with this liquid, and covered

with a wooden pill-box, or a wine-glass, a number of small vesicles were produced; and by this means a suppurating surface could be quickly obtained.

The second indication to procure the discharge of the products of inflammation in the trachea, is to be attempted through the operation of emetics and expectorants. The tartar emetic before recommended is the most suitable medicine whilst the pulse retains its force and regularity; and it may be pushed to the extent of inducing vomiting two or three times in the day, if the hourly doses should be insufficient to have this effect; but this must not be done without caution and due regard to the strength of the patient. When the inflammatory symptoms have in great measure subsided, and the continued croupy breathing is caused by the false membrane with spasm, a less debilitating emetic, such as tincture of squills (℥ss ad 3j) with sub-borate of soda (gr. x ad gr. xx,) in warm decoction of senna or infusion of camomile, or ipecacuanha wine (3ij ad 3ss) with ammoniated tincture of valerian (℥ xv ad 3ss) in some convenient vehicle. Looseness and fluidity of the secretion of the air-tubes, and a consequent facility to expectorate it, are materially promoted by alkaline medicines, which seem to possess considerable attenuant power. Hence, probably, the efficacy of warm alkaline baths, which have been recommended by several authors, and which are useful adjuvants to the other remedies both in the early and later stages of croup. In the early stage, the temperature may be about 92°; but when the inflammatory stage has subsided, it should not be less than 96°; and this heat should be kept up during the whole time of immersion, which may be from half an hour to an hour, or even more, if it afford marked relief. It has been advised by some writers to promote expectoration by means of inhalation of the steam of hot water, rendered stimulant and antispasmodic for the after stages by additions of camphor, æther, and ammonia. The application of these remedies is not easy in young subjects, especially when the breathing is already so embarrassed; but they may be sometimes advantageously used, particularly in the more spasmodic cases, by holding under the patient's mouth a jug of very hot water with the medicines added. The use of a sternutatory, in form of strong snuff gently blown into the nostrils, has also been found to aid the removal of the albuminous deposit from the air-passages, and in a measure to relieve the symptoms.

We have already mentioned some of the means calculated to diminish the spasm which so commonly adds to the constriction of the air-passages; and when, from the more remittent character of the croupy breathing, this spasm seems to be a chief cause of the difficult breathing, besides emetics, which are the most effectual, antispasmodics, assafoetida, æther, musk, camphor, and opium, may be employed with some benefit; but they must be given with caution, and still in combination with calomel and ipecacuanha. Counter-irritation of the sides of the neck, by means of flannel wetted with oil of turpentine and æther, or even the strong liquor ammoniæ, and covered with oiled silk, or a glass vessel inverted over it, to prevent evaporation, is a powerful means of relaxing spasm, and one that causes less risk than internal stimulants.

In the last stage of croup, when the inflammatory symptoms have given place to those of prostration and collapse, the effects of unsubdued disease and of the unsuccessful lowering treatment, the only resource is in stimulants and cordials, by which the powers of life may perchance be excited until the respiration be restored to a better state. Dr. Cheyne remarks, that this is "a time when we may with advantage lay aside all lowering remedies, and give burnt brandy and ammonia, to which may be added calomel with a minute quantity of opium, and the application of spirit fomentations to the surface. Gasping, failure of the pulse, a pallid or livid and clay-cold surface, show that our only faint hope is in cordials: it must be admitted, however, that a clear discovery of the point at which this change of treatment ought to take place, is the reward of clinical experience alone, and cannot be made in the closet." (*Cyc. Pract. Med.*, art. CROUP.)

It is unnecessary to dwell on the modifications in the treatment required in the varieties of the disease which have been noticed; they will be suggested by the

character of the symptoms. Thus, cases of the asthenic form of croup will ill-bear blood-letting; and, should the disease be unsubdued, may very soon require the exhibition of stimulants in addition to the other remedies. Both in it, and in the catarrhal varieties, blisters are more beneficial than in the sthenic form. In catarrhal croup, also, purgatives are useful throughout the disease; and they do not, as in the bronchitis of adults, tend in any degree to check the expectoration. The expediency of using antispasmodics, in the more spasmodic form, has been already adverted to.

It is not necessary to discuss the question of the propriety of resorting to tracheotomy in croup; as it has been decisively negated by Dr. Cheyne, Mr. Porter, and other of the best authorities. The trachea of young subjects is so small, vascular, and difficult to open, and, above all, the obstructing matter of croup so frequently extends into the bronchi, or cannot be dislodged, even from the trachea, through an incision, that the dangers are many, and the chances of success so few, that in general it can scarcely be said that the performance of the operation is justifiable.

The subjects of croup are very liable to a relapse during their recovery from the disease. The increase vascularity of the sub-mucous tissue, and the augmented irritability of the muscular fibres of the trachea and larynx, may continue, although not to sufficient extent to cause croupy symptoms; but whilst this is the case, slight exposure to cold, the too early use of animal or stimulating food, or the hasty suppression of a free action of the bowels, or of a discharge from a blistered surface established for the cure, may excite the inflammation afresh, and bring back the stridulous breathing. In these relapses, the disease has commonly more of a spasmodic character than in the first instance, the phlogistic condition of the body having been reduced by the previous treatment. It is of great importance to watch patients during their recovery, and to guard against the recurrence of the disease, by continuing to give occasional moderate doses of mercurial purgatives, and an expectorant mixture with an alkali; and to maintain some degree of counter-irritation in the vicinity of the neck, by means of tartar-emetic solution or an ammoniated liniment. Even after apparent recovery, the child should be kept warmly clothed, and not be permitted to venture out of doors, until the season becomes mild, and there is no easterly wind. It may often be requisite to remove to a warmer climate, especially to a southern or western coast. When the season is warm, however, and the complaint entirely gone, relaxing heat is to be avoided; the throat and chest should be daily sponged freely with vinegar or salt and water, and afterwards the whole body well rubbed with a coarse towel.

LARYNGISMUS STRIDULUS.

History and causes.—Nature.—Diagnosis.—Prognosis.—Treatment.

Of spasmodic affections of the larynx, the most remarkable is that which affects infants, and has been called *Laryngismus Stridulus*—*Asthma Infantum*—the *Crowing Disease*—*Spasm of the Glottis*—*Spasmodic Croup*, &c.

History and Causes. In the first instance the attacks generally come on during sleep: the child starts suddenly, and, instead of crying as usual, struggles for breath, the face becoming flushed, swollen and even purple: after repeated efforts a long inspiration takes place, often accompanied with a hooping or crowing noise, and the child then recovers its breath and voice, and generally bursts into a fit of crying, sometimes remaining dull and heavy for two or three hours after. These attacks are apt to come on more frequently during sleep, and whilst the

child is awake, particularly on being irritated, or too suddenly tossed in nursing, or on being exposed to a cold wind. The infant will then throw his head back, and struggle for breath, recovering it with the noisy inspiration before described. This noise is not however constantly observed, and depends on the partial opening of the rima glottidis; in some cases it is opened completely, and there is no crowing, just as the hooping is occasionally absent in pertussis. In the intervals there may be no disorder of the breathing or of the general health, but more commonly it attacks children that are delicate and irritable with disordered bowels. It is apt to occur during the period of dentition in children who are badly fed and much confined in too warm or ill-ventilated rooms. In severe cases it may return several times in the day, and as the fits become more frequent, they last longer, sometimes pass into general convulsions, and have in many instances proved fatal.

According to Drs. J. Clarke, Cheyne, and Marsh, this affection is often accompanied with a convulsive contraction of the hands and toes, the hands being clenched on the thumbs, and the great toes drawn in: these circumstances, together with the fact that general convulsions sometimes succeed, have induced these writers to consider the crowing disease as symptomatic of incipient disease of the brain. Dr. Cheyne relates three cases in which examination after death discovered such lesion: in one, scrofulous tumours in the brain; in another, venous congestion and serous effusion; in the third, induration of the brain and obliteration of the convolutions. In two fatal cases Dr. Merriman found no trace of cerebral lesion, but only a collection of enlarged glands in the lower part of the neck, which appeared to have pressed on the par vagum. The late Dr. Ley was led by these and similar cases to ascribe the crowing disease to the influence of enlarged glands or other tumours compressing and partially paralyzing the recurrent or inferior laryngeal branch of the par vagum. Frank and Kopp in Germany have found an enlarged state of the thymous gland in some cases of this disease; and the latter has therefore named it *asthma thymicum*. They appear to refer it to direct pressure on the air-tubes, but it is more probable that an enlarged thymous gland would at first act by compressing the recurrent nerves. It had long been known that the section of this nerve or of the par vagum above its source occasioned a permanent contraction of the glottis, sufficient to suffocate quickly. Magendie and others concluded from this experiment that this nerve supplied the muscles which open the glottis, and that those which close it are influenced by the superior laryngeal nerves. Dr. J. Reid has however lately shown that the latter are chiefly sensitive, and not motor nerves, and that nearly all the motions of the larynx are affected by the recurrent nerves. We cannot then explain the closure of the glottis on the division of the recurrenents, without referring it to a reflex action on the constrictor muscles through the sensitive nerves. The facts however that division of the recurrent nerves causes closure of the glottis, and that aneurisms and other tumours pressing on them have been known to occasion fits of difficult laryngeal breathing, form so far a fair ground for the view of Dr. Ley, that we may admit that enlarged lymphatic glands may sometimes have a similar effect. It has been objected by Dr. M. Hall, that were paralysis the cause, the affection ought to be permanent and not in fits; but this objection is not valid, for the paralysis is not supposed to be perfect, but that the muscles which it affects are unable to antagonize the constrictors of the glottis only when these are unduly excited by the immediate cause of the paroxysm. The effect of such a pressure as can be exerted by enlarged glands would be a weakening of the motory power of the recurrenents, rather than a paralysis; and its influence would be manifest in the power to keep the glottis open, failing only when the act of crying, vomiting, a sudden fright or the like cause, tends to close it with more force than usual. But although disposed to admit the condition described by Dr. Ley as a common cause to the crowing disease, particularly in its milder forms, we think that there is sufficient evidence to show that it is sometimes symptomatic of cerebral disease and the forerunner of convulsions, or some other formidable symptom of cerebral disease. The cases of Dr. Cheyne

point to this conclusion; and we may mention one of a child long under our care, which, after being subject to attacks of this affection for nearly two years, became idiotic. The muscular apparatus of the glottis is so nicely adjusted, and the aperture so narrow in children, that any disease of the nervous system affecting the motory apparatus is very likely to be manifested first here; afterwards as it becomes farther advanced, by contraction of the hands and feet; and ultimately by more general convulsions or by paralysis, according to the nature of the lesion. But we do not consider that slight attacks of the croupy inspiration are always to be referred either to pressure on the recurrent nerves or to any permanent lesion of the nervous system. The crowing noise which many quite healthy children make on being too abruptly tossed in the air, or on being exposed to a high wind, obviously proceeds from a momentary contraction of the glottis under the excitement of the sudden motion. This shows how readily this contraction may be excited; and it is rational to suppose that other causes of mere irritation to the nervous system, such as dentition, disordered bowels, and worms, may occasionally produce the same effect, without inducing any farther mischief. Like other spasmodic affections, spasm of the glottis may be induced by temporary irritations as well as by permanent changes of different parts of the nervous system.

Diagnosis. The absence of fever, the suddenness of the attacks and of their cessation, and the freedom of the respiration in the intervals, distinguish this affection from croup. The absence of cough prevents it from being mistaken for hooping-cough. The character of the crowing sound, and the absence of signs of any disease of the chest distinguish it from all other affections of the respiratory organs.

Prognosis. From what has been stated as to the nature of the affection it may be inferred that it varies greatly in its importance. When it proceeds from teething or disorder of the bowels, it may cease as soon as the source of irritation is removed. The fits themselves may prove fatal by lasting so long as to cause asphyxia; but we apprehend that this will rarely happen unless there be some permanent disease or great weakness of the system. But if the fits recur frequently and are excited by slight causes, there is considerable danger of cerebral congestion or effusion and convulsions being induced by the frequent interruptions to the respiration and circulation. For this reason the frequent recurrence of the fits is dangerous, even if there be no sign of permanent disease in the system. If there be contraction of the fingers or toes, the case is still more formidable, but still not hopeless; for even this symptom may be caused by temporary irritation of the nervous centres. If the affection can be traced to glandular swellings in the neck, or to similar or thymous tumours within the chest, it may generally be removed by prompt and judicious treatment; but if neglected and allowed to become habitual, it may soon destroy the general health, and prove fatal either of itself or by inducing other disease.

Treatment. The paroxysm is of so short a continuance, that there is scarcely time for the application of remedies to remove it. If it threaten suffocation before the crowing inspiration announces its decline, it may be useful to dash cold water in the face, or to blow forcibly into the ear of the little sufferer: these impressions will often succeed in relaxing the spasm, although they are sufficient to excite it when not present. Antispasmodics have very little effect. When the fits come on very frequently, the warm bath may be used, if it can be done without fretting the child, which must be avoided as much as possible, as tending to excite the fits. Dr. Marsh mentions a case of a child two years old, in which very frequent attacks complicated with general convulsions were stopped and suspended for a month after the administration of a tobacco enema (v gr. infused in $\bar{5}$ j of water.)

The most important part of the treatment is that directed to remove the causes of irritation, to improve the general health and the tone of the nervous system, and thus to prevent the recurrence of the paroxysms. When the affection is connected with teething, the gum should be divided in any part where it is hot or swollen,

whether a tooth be pressing or not. Teeth often irritate long before they are cut; and although the incision of the gum over them do not effect their extrusion, and may by taking blood from their capsules even retard this process of dentition, it relieves the irritation which they occasion. A judicious course of purgative medicines will be found useful in almost every case, beginning with mercurials followed by castor oil, and keeping up their action by daily doses of rhubarb and magnesia or sulphate of potash, or by some of the stronger purgatives if the bowels are torpid, recurring occasionally to the mercurials whenever the excretions are clay-coloured or too dark. Dr. Merriman recommends that aperients be used so as to produce at least two full evacuations daily. Dr. Joy mentions a case in which, after purgatives and change of air had failed, the affection was removed on the occurrence of a spontaneous diarrhœa. Whenever there is any appearance or suspicion of the existence of glandular swellings, as a cause of the disease, it will be proper to exhibit a course of alkaline medicine with small doses of the hydriodate of potash. Dr. Merriman found that the continued use of soda, or a strong infusion of burnt sponge, materially contribute to the cure of the complaint; and this is quite in accordance with the view that he and Dr. Ley have taken of its nature. In case of convulsions or an approach to them shown by contractions of the fingers and toes, strabismus, &c., it may be necessary to draw blood from the temples and nape by leeches or cupping, and to apply cold to the head, while the lower extremities are bathed in warm water. But it often happens that there is an atonic or anæmic state of the system rather than plethora: in such cases blood-letting is eventually hurtful; and much benefit may be derived from the judicious administration of tonics, preceded by and combined with aperients.

All writers agree in considering the management of the regimen and food of the greatest importance in this disease. Change of air is often of more avail than any system of medication; and the child should be carried out into the open air as much as possible, only avoiding cold winds; and its apartments should be well ventilated without exposure to partial currents. If it do not bring on the attacks, free sponging of the body with cold salt water every morning should be practised; or if the child be very delicate, it may be used tepid. The clothing also requires particular attention; in cold weather, a sufficiency of warm woollen clothes must be worn, and on no account should the arms and chest be left uncovered from October to June; the neglect of this precaution through the vanity of mothers, has occasioned the sacrifice of many children. The food should be nutritious but simple, given at regular hours and not more in quantity than the stomach can digest; if the child is under twelve months of age, it is by far the best plan to nourish it by the breast only to the sixteenth or eighteenth month, due attention being paid to the health of the nurse and changing her if necessary; but when this cannot be accomplished, the best first substitute is asses' milk or cows' milk, a little sweetened and diluted with half its bulk of lime-water or pearl-barley gruel. For children above the age of two years, milky and farinaceous food with a little meat or broth alternately once a-day, will generally be most suitable.

NERVOUS AFFECTIONS OF THE LARYNX, IN THE ADULT.

1. *Spasmodic affections of the larynx in the adult* are generally connected with some inflammatory or organic disease there, or by the presence of a foreign body; but occasionally they occur as the result of more distant spinal or nervous

irritation, under the garb of hysteria. The sensation called *globus hystericus* is sometimes distinctly attended with a spasmodic constriction of the glottis, which is probably excited by wind in the stomach or even in the œsophagus, for it is generally relieved by flatulent eructation. The choking sensation produced on swallowing too large a morsel is also in part owing to the spasm of the glottis: all these associations of symptoms are rendered more intelligible by the experiments of Dr. Reid, which prove the sensations and motions of both pharynx and larynx to depend on the same nerve—the vagus. More rarely the constriction is of a more enduring kind, and accompanied by fits of croupy breathing and a convulsive ringing cough. Like the crowing inspiration of infants, this may arise from temporary irritation, or from more permanent disease of the nervous centres. Dr. Stokes mentions cases in which spasmodic affections of the larynx terminated in inflammation of, and effusion under, the membranes of the brain. The same writer describes another case in which a patient, long tormented by all kinds of hysterical disease, with occasional obstinate fits of laryngeal spasm and cough, died suffocated by an abscess involving the cricoid, without any other organic lesion. May this abscess have originated in a tumour, which caused by reflected spinal irritation the long train of spasmodic symptoms from which this patient had suffered? Nervous affections of the larynx chiefly affect females, and may present all the degrees of inconstancy and intractability which disorders called hysterical often exhibit. If not rendered inveterate by indulgence or habit, they may sometimes be resisted by an act of the will: we have known a most violent form of convulsive cough with stridulous breathing, which had resisted every kind of treatment, cured through the patient's hearing the actual cautery prescribed for the next attack.

The *treatment* of spasmodic affections of the larynx is to be generally conducted on the usual principle, of giving antispasmodics to remove or prevent the attacks, and improving the tone of the muscular system and diminishing nervous irritability by tonics, regular exercise in the open air, and other suitable means. Foreign bodies in the larynx and even in the œsophagus may excite violent and fatal spasm of the glottis. The treatment of this subject belongs rather to surgery than medicine.

2. *Atonic or paralytic affections of the larynx* are chiefly known by the symptoms of aphonia, hoarseness, or some other alteration of the voice. This symptom is commonly connected with inflammatory or structural disease of the vocal apparatus: but even in these the sudden exacerbations show that much of it is nervous: and in nervous and hysterical subjects we not unfrequently find affections of the voice independent of any other disease of the larynx. Some persons not unfrequently lose their voice from sudden mental emotion, taking particular articles of food, menstrual irregularities, and other causes which operate on the nervous system; and the sudden manner in which they often regain as well as lose the voice, sufficiently points out the nature of the affection. We had the care of a lady, who from such causes is liable to lose suddenly not only her voice but also her power of articulation for days together, and to regain them as suddenly. For some time relief was instantaneously given, merely by her taking an electric spark with her fingers. This at last lost its efficacy, and even shocks failed; subsequently it was found that holding a lump of ice in the mouth was quite effectual. The complaint originated in a low fever, and the liability to its recurrence has diminished with the improvement of the general health under the use of mild metallic tonics with change of air. At present the attacks are rare, of short duration, and may be removed by drinking a little wine. The affections of the speech often preceding and accompanying general paralysis, are those of articulation rather than of the voice. But the voice is often changed or suppressed in attacks of violent palpitation, and particularly in cases of aneurism involving the arch of the aorta, the innominata, or right subclavian artery; and this circumstance is obviously referrible to the manner in which the recurrent nerves are stretched or compressed by these tumours.

Nervous aphonia is generally symptomatic of some other general or local disease: its treatment therefore must vary according to the nature of the primary affection. In the purely nervous or hysterical cases, the fetid gums and other stimulants as temporary means, and a course of steel and other tonic medicines, with free exposure to a healthy air, the shower or plunge bath, and corresponding regulation of the mode of living, comprise the measures most likely to be successful. But sometimes either with or without those more remote causes, the local affection depends in great measure on relaxation or weakness of the muscles concerned in the formation of the voice. In such cases stimulant and astringent gargles, as of port wine, alum, infusion of rhatany root, or even a weak infusion of galls, will prove useful. The injection of a solution of sulphate of zinc or of nitrate of silver in the manner recommended by Trousseau, and described in the treatment of chronic laryngitis, would probably be still more efficacious. We have known several instances of clergymen, whose vocal organs have been weakened and relaxed by over-exertion, in which much benefit was derived from the use of astringent gargles. A piece of camphor kept in the mouth for some time before speaking is also of use. In some cases, the relaxation may be removed by the internal use of the balsams of capaiba or Peru. But unless there be a temporary suspension of all extraordinary exertions of the vocal organs, the effect of all these remedies will be very transient.

CATARRHAL INFLAMMATIONS.

ACUTE CATARRH.

General observations on catarrhal inflammations.—Symptoms of Acute Catarrh.—Coryza.—Mild Bronchitis.—Physical signs.—Causes.—Treatment.

By Catarrhal Inflammations of the air-passages is meant, those affections which are attended by an increased and altered secretion from the mucous lining of the tubes. From their most frequent cause they have received the common name of *colds*; and they are farther distinguished according to their seat. Thus, in the nasal canals, the complaint is called *a cold in the head*, *coryza*, or *nasal catarrh*; in the fauces, it is *catarrhal sore throat*, or *cynanche*; whence it may branch off by the Eustachian tube, causing *deafness* and *earach*; or by the lachrymal duct, causing *catarrhal ophthalmia*, or *a cold in the eyes*. In the larynx and trachea, and its branches, it constitutes a *catarrh* or *cold in the chest*; in which case, from its most prominent symptom, the complaint is called *a cough*. Although, by a few writers, this affection of the mucous membrane of the air-passages has been considered not to be essentially inflammatory, we do not hesitate to class it as such, for its course and phenomena are undoubtedly those of inflammation; and to reckon it otherwise, because there may be something specific and non-inflammatory in its origin, would be to follow a doubtful hypothesis, rather than plain fact.

The divisions which we purpose to adopt, are made with a view to important practical distinctions, rather than because they exist naturally; for the different affections, thus separated, pass by imperceptible gradations into one another. The more acute catarrhal inflammations of the air-tubes, present especially two forms, which vary greatly in their severity, on account of their difference in extent and the situations which they occupy. 1. *Acute Catarrh*, which in the nasal passages is *Coryza*, and in the upper parts of the air-tubes a form of *Mild*

Bronchitis; and 2. *Bronchitis*, which affects the air-tubes more extensively, and by its effects interferes with the function of the lungs.

Symptoms of Acute Catarrh. The first symptom of catarrh, or, as it is popularly termed, a *cold*, is generally a feeling of fulness or obstruction in one or both nostrils, or a sense of tickling or relaxation in the throat, with an uncomfortable sensation in the stomach, approaching to nausea, and attended with flatulence; or, in those more liable to cough, it may begin with tightness and uneasiness in the chest, with slight hoarseness, and irritation of the glottis. Any of these are commonly accompanied by some feeling of chilliness, occasionally with slight rheumatic pains, which are sometimes the first symptom, and indicate the general disturbance which precedes the localization of the disease. As yet it may be uncertain what form the complaint may assume, although most individuals know from experience the course which it is likely to take in their own persons.

When it becomes developed as a *Coryza*, or cold in the head, there is a sense of fulness and obstruction of one or both nostrils, accompanied by the secretion of a thin colourless fluid. This flux comes on from time to time in an increased quantity, and the increase is always attended by an aggravation of the uncomfortable feelings of fulness and tickling, with frequent sneezing, and copious flow of tears from the eyes, which are full and injected: these effects show an acrimony in the discharge, as well as an increased sensibility of the pituitary membrane lining the nasal fossæ: this is farther evinced in the progress of the disease, by the redness and excoriation of the end of the nose, and the skin above the upper lip. The senses of smell and of taste are always impaired, the latter often quite destroyed; there is often headach, or a sense of weight and heat over the brows, supposed by some to be occasioned by the catarrhal inflammation affecting the lining of the frontal sinuses. The partial or complete obstruction of the nasal passages, although caused entirely at this stage by the swelling of the membrane, gives the feeling of their being plugged up: and the same obstruction often renders the voice thick and nasal; subsequently it becomes husky from the swelling of the laryngeal membrane. If the attack be severe, there is fever, with loss of appetite, and pains of the back and limbs; and in almost every case an unusual degree of chilliness and sensibility to cold. The disorder is at its height generally about the third day, and then begins to decline; the flow from the pituitary membrane becomes more scanty and viscid, and less acrid, the lachrymation ceases, the swelling and obstruction diminish, while the headach and other symptoms proportionately abate, and between the fifth and seventh day the disorder may be entirely removed. Not, unfrequently, however, fresh cold is taken from the slightest cause, and the coryza, with its attendant symptoms, is kept up for a longer time; and so long as the secretion is copious and thin, no amelioration of the other symptoms takes place. Still more commonly, as the irritation of the nasal passages subsides, that in the throat and larynx begins. The inflammation seems to be of the creeping or erysipelatous kind; and may wander along the Eustachian tube, causing dulness of hearing, perhaps with earach; along the fauces, causing sore throat; and down the œsophagus into the stomach, occasioning slight gastric dyspepsia. Its more common course, however, is down the air-tubes, giving rise to the bronchial form of catarrh to be presently described.

Coryza not unfrequently attacks infants, and so obstructs the nostrils, as to interfere with the process of sucking, in which nasal respiration is necessary. The child leaves off repeatedly, becomes fretful, and sometimes purple in the face, in a few seconds after each time of taking the nipple. In children predisposed to convulsions, these efforts, and the disturbed circulation ensuing from them, sometimes prove the exciting cause of a fit.

When catarrhal inflammation extends to the upper bronchial tubes, constituting a form of *mild bronchitis*, it commences with coryza, or sore throat, and increases as the latter affections diminish; but in persons who are liable to coughs, it often is the first effect of exposure to cold. The first symptom is sometimes

a feeling of coldness at the top of the sternum, with roughness or dryness in the throat, which occasions frequent attempts to scrape the throat. Then follow sensations of heat; tightness, soreness, or pain in the same part, with a cough, which is at first short and dry, but soon becomes longer, more urgent, and accompanied by the expectoration of a glairy, saline tasted, transparent mucus. This secretion, so far from relieving the cough, obviously aggravates it by tickling and irritating the glottis, and probably possesses somewhat of the same acrid quality with that of coryza. This acrimony may be owing to the increased proportion of saline matter, which not only is evident to the taste, but has been chemically shown by Messrs. Brett and Bird to exist in the expectoration of bronchitis. The full development of catarrhal inflammation in the air-tubes is usually attended, especially towards evening, with quickened pulse, hot skin, and scanty high-coloured urine, with some degree of fever, and some shortness of breath.

The *physical signs* more clearly mark the condition of the bronchial membrane. In the earliest stage, perhaps, before any cough or other symptom of pectoral disease, various dry *rhonchi*, the *sonorous* and *sibilant*, with a diminution of the respiratory murmur, announce the narrowing of some of the air-tubes. More rarely, a total absence of sound in a part of the chest shows that the obstruction there is complete; while the unimpaired sound on percussion proves that the vascular structure is free. These obstructions, no doubt, arise chiefly from the swelling of the mucous and sub-mucous tissues, as we find the same take place in the nasal canals, when they are the seat of the kindred affection—coryza. Dr. Stokes supposes that a spasmodic constriction of the circular fibres, rendered irritable by the inflammation, contributes to the coarctation of the tubes. The bronchial tubes do not remain long in this dry state; the secretion commencing first gives a roughness to the other sounds, then adds to them a sound of bubbling; which is the *mucous rhonchus*; but this is seldom so loud as the other sounds, and when the disease occupies only the deep-seated tubes, it may scarcely be heard at all. According as the liquid is in the large or the small tubes, the bubbles, and the crackling which they produce, will be coarse and unequal, or fine and more uniform. The usual seat of all these sounds, in the milder forms of bronchitis, is in the middle parts of the chest, whether in front, behind, or at the sides, where the larger bronchi lie. The lower tones imply an affection of the larger tubes; but the acute notes do not indicate that the finer tubes alone are diseased, for they may be produced in the large tubes also, when the obstruction is considerable; and when there is heard an acute or whistling note prolonged through the whole act of inspiration or expiration, it may be known not to be produced in the finer tubes, because the air is not so long a time passing through them. The deep sonorous rhonchus, like the note of a violoncello, is probably seated at the branching off of a large bronchus; and so strong are its vibrations, that it may be often felt by the hand applied to the exterior, or by the patient, who can point out the spot where it is produced. These various sounds may accompany either the inspiration, expiration, or both.

The decline of this mild form of bronchitis is announced by a looser character of the cough, and a change of the expectoration to an opaque, thick, less coherent phlegm, which is generally first perceived in the morning, that being the time when most inflammatory and febrile diseases show a tendency to remission. With this change, there is a general amelioration of the symptoms. The constriction of the chest is diminished or removed, the pulse loses its frequency, the skin becomes cooled by perspiration, the urine more copious and deposits an abundant sediment, and the decline of all the troublesome symptoms very generally corresponds with the altered character of the expectoration. This seems to have lost its irritating quality; is more tasteless; and comes up by easy coughing, in distinct pellets of opaque yellowish-white or greenish-white mucus, to which the soot and smoke of the air in large towns often give a gray tinge. Sometimes the sputa assume a consistent form without opacity, which renders

the cough and expectoration easier, but it is not accompanied by the general improvement so remarkable when the sputa become simply opaque. In either case, the inspissation of the bronchial secretion causes some change in the physical signs; the bubbles are heard to break more rarely, and give more of a whistling or ticking sound; and the sibilant and sonorous rhonchi become remarkable; but they change with every cough or forcible act of breathing. The same clots of mucus that by this partial obstruction to the air cause these rhonchi, sometimes block up entirely one or more of the tubes, and stop the sound of respiration in the part to which the tubes lead. But this stoppage is seldom permanent; and a cough or deep inspiration will often open it or shift it to another situation, and the air is then heard to enter with a whistling or a clicking noise, where all had been silent before. The sound on percussion is still uniformly good; and this circumstance, with the varying respiration and rhonchi, characterizes bronchitis in this stage.

Such is the ordinary course of the slighter cases of mild bronchitis, which may last from a few days to two or three weeks, but if neglected may continue for a much longer period, and assume a chronic form.

Causes. The most common *exciting cause* of acute catarrh, whether affecting the nasal passages or the air-tubes, is exposure to cold or sudden transitions of temperature. This cause is always more effectual when it is partially applied, as by standing or sitting in a draught of air, especially if the body be heated; by wet feet, or wearing damp clothing. Acute catarrhal affections often prevail epidemically, probably depending on sudden atmospheric changes, some of which are, obviously enough, those of temperature, but in other cases they are of a less intelligible kind, being perhaps connected with electric conditions of the air that elude our scrutiny. Certain it is, that the most severe and universal forms of epidemic catarrh have occasionally appeared without being preceded by equally remarkable transitions of temperature. An opinion prevails among many persons, that catarrh is infectious; this rests on the equivocal evidence of their so frequently affecting, consecutively, the different members of a household. A catarrhal affection of the eyes, nostrils, and upper portion of the air-tubes, very generally accompanies measles, and more rarely small-pox and scarlatina. Irritating gases, vapours, or dust, may excite catarrhal inflammation of the pituitary and bronchial membrane; but is of a slight kind, and soon passes away, unless the cause be reapplied.

The only complication of acute mucous catarrh of the air-passages, which it is necessary to notice, is that with disorder of the gastro-hepatic function; in which, in addition to the catarrhal symptoms, there are headach, thirst, a loaded tongue, loss of appetite, occasionally nausea, or even vomiting, sometimes with tenderness at the pit of the stomach, or in the right hypochondrium; sometimes a slightly jaundiced skin and conjunctiva; and bowels constipated or irregularly loose, with dark or clay-coloured dejections. Dr. Copland mentions rheumatism as a disease with which catarrh is sometimes complicated, to which, he thinks, it bears some affinity. We have not observed this complication; and although there are occasionally slight wandering pains, like rheumatism, in the early stages of catarrh, they rarely take the course of true rheumatism.

Treatment. "A cold," which is one of the most common of all diseases, is rarely considered an object of more than domestic treatment; yet, trivial as it is, it is often formidable in its consequences. The ordinary method of treating a cold is, certainly, rather palliative than positively curative; but it generally mitigates its severity, and hastens its termination. A brisk purgative, conjoined, if there be febrile disturbance, with a moderate dose of calomel and James's powder, or tartarized antimony (the mercurial being increased and repeated in case of gastro-hepatic disorder,) a hot pediluvium at night, confinement to a room of moderate temperature, or to bed in order to increase the perspiration, which may be promoted by warm diluent drinks, will generally serve to moderate the complaint. Temporary relief may sometimes be given to the headach and severe catarrhal irritation of the nasal passages, by holding the face, with the head covered with

flannel, over a vessel of hot water; and, in the case of the coryza of infants, the repeated application of a sponge squeezed out of hot water will often succeed in freeing the air-passages for a time, and in thus enabling the infant to suck.

The cerebral symptoms which under these circumstances are sometimes developed in children, are quite serious in their character. Besides using the remedies pointed out by the author, it is often of great service to place a cup filled with tar, which is kept hot by being suspended in a larger vessel of water kept at the boiling point; the vapour of the tar facilitates the secretion from the nostrils, and often greatly relieves the child. Holding the head of the child for a few moments over a vessel of hot water, or of hot vinegar, is often of great benefit, and above all a repeated change of position is advisable, so that by inclining the head forwards the flow of mucus may be facilitated. The coryza of young children is often an affection which causes great annoyance and sometimes danger. G.

When the catarrh extends to the air-tubes, the same mild antiphlogistic plan may be pursued, with the addition, in more severe cases, of leeches above the top of the sternum, or a blister or tartar emetic liniment to the upper part of the chest, and the frequent use of a cough mixture, to diminish irritation and promote expectoration. Various combinations may answer for this purpose. Mixtures containing antimonial or ipecacuanha wine (℥x to ℥xx) with tincture of hyoscyamus or conium (℥xx to ℥xxx) or hydrocyanic acid (℥j.) for the early stage and with tincture of squill (℥x to ℥xx) and compound camphor tincture (℥xx to ℥xl) for the subsequent periods, generally answer well. But the efficacy of these remedies is decidedly increased by combining them with an alkali. From ℥x to ℥xx of the *Liquor Potassæ*, or an equal number of grains of carbonate of soda, or in more asthenic cases ℥xx or ℥xxx of the *Sp. Ammoniæ Arom.*, are sufficient: in the greater number of cases, such alkaline remedies quiet the cough and promote expectoration far better than the oxymels and acid linctus or lozenges that are commonly in use. To have their full effect, cough medicines should be taken frequently, at least four or five times a-day; for, besides that, their object is to increase continually the secretion of the bronchi through the circulation, they seem to act, in some measure, directly on the glottis and its neighbourhood; and in the intervals it is useful to have in the mouth a demulcent substance, such as gum arabic, the solution of which tends, also by continuity, to sheathe these same irritated parts.

In order to ensure the success of this mode of treating catarrh, more or less nursing and confinement is essential. To give diaphoretics and diluents, and at the same time to expose the body to transitions of temperature, which are almost unavoidable without confinement, will tend rather to increase a cold than to diminish it: yet few persons think it worth while to confine themselves for the sake of a cold, and thus either let it run its natural course, or make an even worse compromise, by nursing and sweating during one part of the day, and exposing and chilling themselves at another. Now, as these ordinary antiphlogistic means are inconvenient, and do not succeed in cutting short a catarrhal inflammation, there are other measures, which, if used at the outset of the disease, within a day or two of its commencement, often prove prompt means of arresting it altogether, or of bringing it to a speedy termination.

One of these methods is, by taking at bed-time, at the earliest stage of the cold, (whether the affection be felt in the nasal passages, the throat, the chest, or in the system generally,) a full dose of opium in some form, following it the next morning by a brisk cathartic. From ten to twenty grains of Dover's powder, or two grains of opium with two of ipecacuanha, or a quarter of a grain of tartar emetic, or half an ounce of compound tincture of champhor, are the most eligible forms of opiate. It is safer to add a few grains of calomel or some milder mercurial, to prevent the restraining effect of the opium on the secretions. When the remedy acts well, the patient sleeps soundly, generally perspires freely, and awakes in the morning free from his cold, but often with some headach and nausea. These are

generally relieved by a brisk purgative, and no farther ailment is felt than a degree of languor which another night's rest may remove. This remedy seems to operate by deadening the morbid sympathies, and thus breaking the chain of actions on which the process of inflammation depends; as we find it cut short, in some cases, of more serious inflammations, after the general vascular action has been reduced by blood-letting. Somewhat in the same way may be supposed to act the hot, spirituous, and vinous remedies which are popularly employed to check a cold; and which, hazardous as they are, were in some measure commended by Laennec. This kind of treatment may, however, prove injurious, where the digestive organs are weak, or where a tendency to other inflammations exist; and, by suppressing the expectoration, may change a bronchial catarrh into pneumonia.

Another method of stopping a cold is by abstinence from all kinds of liquid. This plan originated with the writer, who has practised it in his own person for the last twelve years, with such success, that colds and coughs, that used to continue for several weeks, have been generally cured in two or three days. It was first adopted especially in the treatment of coryza, in which, as the earlier stage of catarrh, it is the most successful; but it was soon found to be of great utility in catarrhal bronchitis. About six years ago, M. Piorry also recommended this plan as a means of diminishing the expectoration in various forms of bronchial disease; but it does not appear that he adopted it with the view of removing catarrhal inflammation. The great effect of abstaining from liquid food is promptly to reduce the mass of the circulating fluids. The natural fluid secretions continue, although in diminished quantity; the urine is still excreted, but its watery part is decreased; the skin continues to perspire, either insensibly, or obviously under the influence of increased warmth or exercise. This is not the case with the morbid secretion from an irritated membrane: the irritation is lessened with the decreasing fulness of the blood-vessels; the scantier circulating fluid being now taxed for the habitual and necessary secretions too closely to supply it, the morbid flux soon ceases, and the diseased membrane, no longer irritated by its own secretion, is restored to a healthy condition. If liquid be freely taken too soon, before the membrane has lost its diseased action, the discharge will return and the complaint be as severe as ever. But if, when the discharge has ceased after twenty-four or thirty-six hours of abstinence from liquids, means be taken to keep up the natural secretions, as by exercise, with a warm state of the surface, a little liquid may be taken with impunity, the bulk of the circulating fluid being still below the amount at which it can readily supply any demand from the irritation of the diseased membrane. This is probably the physiological principle of the curative influence of the *dry treatment* on catarrh. It is very essential for its success, that it should be applied in the early irritable stage of the complaint; and it is most effectual when the catarrh affects chiefly the nasal membrane. If there be any fever, and especially if the state of the bowels require it, an aperient with an antimonial should be given; for this favours that free state of the secretions on which, as we have seen, the efficacy of the dry plan depends. In milder cases, this is not necessary. For similar reasons, it is desirable that the solid food be not of a too rich or heating kind; for this, undiluted by liquid, might be apt to disagree. Bread, or any consistent farinaceous food, with a little butter, vegetables, white fish, white or gelatinous meats, light puddings, and dried fruits, are suitable articles for a dry diet. Although a total abstinence from liquids is the most effectual, yet, taking about a table-spoonful of tea or milk with breakfast and the evening meal, and a wine-glass full of water on going to bed, does not prevent the success of the plan, whilst it diminishes its discomfort. But the suffering from this voluntary privation is trifling in comparison with that from a severe cold; in fact, except with those who are habitually thirsty, it is rather negative than positive, arising from the imperfect enjoyment of eating without drinking. A great advantage of this plan is, that it does not interfere with common active pursuits, and needs no nursing or confinement. In fact, if care be taken to prevent the surface from being chilled, exercise in the open air promotes the success

of the plan, by favouring the natural secretions. On the other hand, those who treat their colds by slops and diluents, which act chiefly by increasing the perspiration will suffer from the least transition of temperature, which will have a greater influence on a freely perspiring surface. The time necessary to effect a cure by the dry plan will vary in different individuals, according to the present quantity of their circulating fluid, the activity of their secretions, and the intensity of the catarrhal disease; and also, somewhat according to the hygrometric state of the air, longer time being always required when the weather is cold and damp. On the average, forty-eight hours of abstinence will be sufficient. We have known thirty-six hours enough; but some severe and obstinate cases require three days. The period may generally be somewhat shortened by exercise and warm clothing, or lying in bed, or by commencing with a purgative, or by any other dry means of increasing the natural secretions. The catarrhal affection is generally much relieved at the end of the first day, and only troublesome at times; but the cure is not complete till all *stuffing* is gone, and nothing but a consistent mucus is formed, without irritation in the nasal or bronchial passages. Sometimes this secretion continues for a few days; but, unless fresh cold be taken, it causes no inconvenience, and soon ceases. In these cases, it is generally prudent to take an aperient and diaphoretic on returning to the use of liquids, which it is always best to begin at night, when there is less risk of relapse from fresh exposure.

There is a chronic variety of coryza which is very troublesome; it occurs chiefly in persons of a scrofulous constitution, and although it is not in itself attended with much danger, it is often difficult of cure. The mucous membrane of the air-passages, that is, of the nasal fossæ, is thickened and secretes a large quantity of mucus, which is sometimes altered in its quality and more opaque than usual. The coryza is unattended with pain, but the inflammation in many cases extends to the throat, and then becomes a variety of the chronic pharyngitis which is so common amongst clergymen. The best means of treatment are the alteratives and tonics; that is, the preparations of iodine and sarsaparilla, and stimulant inhalations, especially the vapour of chlorine, tar, and vinegar. These may be alternated with soothing remedies, as the vapour of water. G.

BRONCHITIS.

Acute Bronchitis.—Sthenic and asthenic forms.—Symptoms.—Physical signs.—Infantile bronchitis.—Causes.—Symptomatic bronchitis.—Anatomical characters.—Diagnosis.—Prognosis.—Treatment of the sthenic and asthenic forms—of infantile bronchitis—of the various forms of symptomatic bronehitis.—Chronic bronchitis.—General observations on chronic inflammation of the air-passages.—Characteristic symptoms of chronic bronchitis.—Causes.—Anatomical characters.—Prognosis.—Treatment of chronic bronchitis.—Diet and regimen.

ACUTE BRONCHITIS.

THE more intense form of acute bronchitis differs from the milder kind already described, in the greater extent of the bronchial tubes which it occupies, rather than in pathological character. Its local nature and signs are the same; but its general symptoms differ, inasmuch as the system suffers more from the greater intensity and extent of the inflammation and of the functional disorder. This disease presents itself under two forms, long distinguished by the terms *sthenic*

and *asthenic*. In sthenic bronchitis, inflammatory symptoms are marked from the commencement: there are generally pain, and constriction across the sternum; hard severe cough, with glutinous expectoration; much fever, heat of skin, thirst, headach, and scanty urine; white tongue, with red edges; quick and often hard pulse; hurried breathing, often accompanied with a feeling of great oppression; and cough on the least exertion. The pain in the chest is commonly referred to the sternum, and is more obtuse than the pain of pleurisy. The expectoration is usually scanty at first; afterwards it becomes more copious, glairy, frothy, sometimes streaked with blood, and its expulsion gives but little relief to the cough and breathing: it is compared by Andral to white of egg in different degrees of dilution, and from chemical analysis appears to contain free albumen, which is not present in healthy mucus; its quantity increases in the evenings, when there is a general aggravation of all the symptoms, more especially of the fever, dyspnoea, and cough. The physical signs are similar to those of the mild form; but they are here heard more extensively throughout one or both sides of the chest. The rhonchi are at first sibilant and sonorous; afterwards mucous and sub-mucous, reaching to the inferior portions of the lungs, with a weakened respiratory murmur, announcing the presence of the inflammatory mucus even in the smaller tubes: but the clear sound on percussion declares the vesicular structure still free.

If relief be not afforded by expectoration, perspiration, or prompt remedial measures, the disease soon shows a change of character, from the increased dyspnoea, and symptoms of partial asphyxia that ensue. Then come on feelings of great depression; the pulse is weak, as well as very quick, and often irregular; the functions of the sensorium are impaired or disturbed; the muscular strength is much reduced; the countenance becomes anxious, and pallid, or partially livid, according to the quantity of blood in the system; partial sweats appear; the pulmonary congestion becomes evident, by the slightly diminished resonance on percussion in the postero-inferior regions of the chest. The continuance of this state, and the imperfect arterialization of the blood, farther disturb other functions; the secretions become more scanty and vitiated; the tongue is loaded with a brown fur; the thirst is intense; and all these disorders concur in re-acting on, and aggravating the original disease, and in injuring the natural powers. Such is the loss of balance that results from the disturbance which severe bronchitis makes on the important function of respiration. The share which this function has in giving character to the constitutional symptoms, is seen in the fact, that very similar effects are met with in persons who have been subjected to an asphyxiating influence. The step from this condition to death is but a short one. In favourable cases, the disease declines between the fourth and the eighth days; the dyspnoea is diminished, and is confined chiefly to the evening, when there is almost always some tendency to exacerbation. The expectoration becomes opaque, and less glutinous and frothy; and on being voided, gives more relief to the cough and dyspnoea. The breathing becomes less laboured; the countenance improves, and resumes its proper colour; the symptoms of fever abate; and the disease either entirely subsides, or passes into a chronic form.

The chief difference presented by the asthenic or humid form of bronchitis (*peripneumonia notha*, as it was formerly termed,) is the early appearance of signs of depression, generally attended with gastric derangement; quick, wiry, often irregular and unequal, pulse; hot skin towards evening; headach, and thirst. Oppression of the breathing is here one of the earliest symptoms, accompanied by a peculiar wheezing; and, on auscultation, we find in the universal mucous rhonchus the proof of the early presence of a profuse secretion in all the tubes. The dyspnoea is liable to temporary exacerbations, which are often so severe as to prevent the patient from lying down, and are accompanied by extinction of the voice. During these attacks, there is sometimes some dulness on percussion, and occasionally even bronchophony in the posterior region on one side, which is removed with the decrease of dyspnoea. These probably depend on the quantity of liquid mucus in the bronchial tubes and cells; and on a temporary pulmonary

congestion. The expectoration may be scanty at the outset, but afterwards becomes very copious and frothy. This form of bronchitis commonly attacks elderly people, those of a lax phlegmatic habit, and such as have habitually a cough with copious thin expectoration. In young children, a very fatal kind of bronchitis of the asthenic kind sometimes comes on in a most insidious manner. It may at first present the aspect of a common catarrh with coryza, without pain, much fever, or marked derangement of the functions. On attentive observation, however, the breathing is observed to be frequent, accompanied with wheezing, particularly before and after the fits of coughing; while the pallidity of the countenance, and heavy state of the child's spirits, indicate something more than a common cold. The cough is not always present; and as children do not expectorate, the disorder in the chest may escape remark, until the dyspnœa suddenly comes on and renders the danger imminent.

Causes. The most common exciting causes of severe bronchitis are the same as those of the milder form of the disease, from which, as we have before observed, it differs rather in degree than in kind: cold, particularly conjoined with moisture, applied locally or generally, as by wearing damp clothing, or exposure to a cold, moist, variable atmosphere, especially after the body has been heated by exercise or crowded rooms. Particular conditions of the atmosphere may excite sthenic bronchitis in those of an inflammatory habit; and the humid form of the disease in those of a more relaxed constitution. A severe kind of bronchitis often accompanies some of the eruptive fevers, measles, erysipelas, small-pox, and scarlet fever, and causes the chief danger that accompanies them. In some cases, the recession of the rash is followed by great increase of the bronchial affection, which is announced by sudden and oppressive dyspnœa. From the suddenness of the production and disappearance of this symptom, which is occasionally observed in these cases, it is very probable that they are rather congestive than inflammatory; although, if the congestions continue, they take the form of bronchitis. Of the same character is the symptomatic bronchitis of continued fevers, in which the symptoms of the local disease are often so obscured, that it may run on to a fatal termination without being discovered, till its nature has been revealed by dissection after death. Auscultation in such cases, however, generally reveals the lesion—the sibilous, sonorous, and sub-mucous rhonchi being heard in every part of the chest. Bronchitis supervening on erysipelas sometimes depends on the propagation of the inflammation by continuity, and may prove rapidly fatal. Erratic gout may manifest itself also in the form of bronchitis, which may be dangerous if the attack be sudden: in general, it vanishes quickly on the appearance of gout in an extremity.

The *anatomical characters* of acute bronchitis, as far as they present themselves, correspond with the indications of the physical signs. The lungs do not, in general, collapse on opening the chest, the escape of air being prevented by the obstructions in the bronchial tubes. These tubes, in most instances, contain a quantity of frothy fluid, similar to expectoration, before death: not unfrequently it is sanguinolent; but as this appearance is not often observed in the sputa, even at the last, it probably arises from an exudation of the colouring matter from the congested pulmonary plexus of vessels at the time of, and after, death. Purulent matter is frequently mixed with the mucus, especially in very acute sthenic cases, which have proved fatal in a few days. The bronchial mucous membrane presents various shades, from a light pink or crimson, to a deep or brownish-red, either generally diffused or in patches. It is occasionally found partially thickened, but much less commonly than might be expected from the character of the physical signs, which so generally indicate constriction of the tubes; but it is to be borne in mind, that the vascular injection and effusion, which chiefly constitute these constrictions, probably resemble those of erysipelas, which, it is well known, disappear after death. Occasionally the mucous membrane is somewhat softened, so that it may be easily abraded; but this change is found by no means so frequently as in the gastro-intestinal mucous membrane.

Diagnosis. The distinctive characters of acute bronchitis are to be found in the leading general and physical signs of the disease. Its most important symptoms arise from its interfering with the function of respiration, and occasioning the circulation of dark blood through the system, with corresponding changes in the hue of the lips and cheeks, which result sooner from bronchitis than from other inflammatory affections of the chest. It should be kept in view, that more or less bronchial inflammation always accompanies these other pulmonary affections in their more serious forms, and is often the immediate cause of death. One of the most rapidly fatal forms of tuberculous disease, is that of abundant miliary tubercles, attended by a general bronchial inflammation, the secretion from which is the chief cause of the dyspnoea and suffocation which ensue. So also in continued fevers, as it has been pointed out, a secondary bronchial inflammation or congestion and effusion become a chief source of danger, although it may be difficult to distinguish it among the symptoms of the primary disease.

On the character of the sputa, a diagnostic between bronchitis and pneumonia has been founded: those of the former, although sometimes very viscid, wanting the rusty tinge which is presented by the expectoration of peripneumony. We shall see, hereafter, that hæmorrhagic engorgement, or a highly congested state of the lungs from organic disease of the heart, may add even this character to the sputa of bronchitis. But in bronchitis the air is not expelled from the vesicular structure, as in the effusions of pneumonia and pleurisy: hence, although, from temporary congestion, the sound of the chest on percussion be sometimes impaired, it is not so to a great extent, or for a continuance; neither is there such condensation of the tissue, as to transmit the sound of bronchial respiration or bronchophony. The absence of the fine crepitation of pneumonia is a more equivocal test; but if observed, for two or three days, without dulness on percussion and rusty tinge in the sputa, it may be considered as pretty surely indicating that the parenchyma is not influenced. It is important to bear in mind, notwithstanding the artificial distinctions insisted on by Laennec and others, that the physical conditions of a congested lung with acute bronchitis, and of a lung in the first stage of pneumonia, are the same as far as regards their signs, and can be distinguished only by the different courses which they take, and which will depend on the degree of inflammatory tendency present, as indicated by the cough and general fever.

Prognosis. The tendency of acute bronchitis may be judged by the extent and stage of the disease, and the general strength and condition of the patient. When the inflammation is partial, affecting a few bronchi only, as in common mild cases, and without much dyspnoea and fever, it may terminate in a period varying from six days to three or four weeks; and its disposition to pass off is indicated by the expectoration becoming opaque and more clotted, and gradually diminishing in quantity. This change is always first seen in the morning; the evening exacerbations often restoring the thin glairy character to the sputa, even in cases tending towards convalescence. A relapse is marked by the expectoration resuming this condition, which is always accompanied by an increased hardness of the cough and fever. In the more extensive attacks of inflammation, where the dyspnoea is oppressive and constant, and particularly where the fever is high in the beginning, the prognosis must be very doubtful. If the acute symptoms have already yielded to the state of collapse, it may be feared that the power of the system will be insufficient to restore a function on which the disease has made a serious inroad. The extreme anxiety of the pallid countenance, with more or less lividity of the lips, of the face, and hands, coldness of the surface, and a rapid fluttering or thready pulse, announce the asphyxiating effects of this stage of the disease; and the universal mucous rhonchus becoming coarser and more gurgling as expectoration fails, with little or no respiratory murmur heard on applying the ear to the chest, gives direct evidence of impending dissolution.

In the severe bronchitis of children, the real amount of danger can seldom be estimated by the general symptoms, in time for the effectual application of remedies;

but where auscultation discovers, from a widely diffused mucous rhonchus, that the inflammation is extensive, and occupies both lungs, great danger may be apprehended, whatever be the amount of dyspnœa and other symptoms at the time; for frequently these come on in paroxysms only, or are scarcely remarked in the somnolent state in which the child lies during the remissions.

The chief danger in asthenic bronchitis arises from the weakness or age of the patient. As long as expectoration continues free, and the strength keeps up, the lungs may be cleared of the secretion fast enough to maintain their functions; but the disease is often fatal to the weak, and especially the aged, whose lungs are generally more or less emphysematous, and therefore can ill afford any infringement on their function. One of the most fatal forms of bronchitis is that supervening on a suppressed eruption, or on erysipelas.

Treatment. As long as the *sthenic* character of bronchitis continues there can be no doubt of the propriety of bleeding, more or less freely, by venesection, cupping, or leeches, according to the intensity of the symptoms, and the strength of the patient. In bronchitis, occasional moderate blood-letting (from 12 to 20 oz.) generally gives speedy relief, by removing the congested state of the lung; and in this respect bronchitis differs from pneumonia, in which this congestion is a more fixed part of the disease. It is desirable, however, to produce an impression on the pulse, which often increases in fulness as the blood flows, while the temporary congestion is relieved. But inflammation of a mucous membrane is rarely removed by bleeding alone; it involves a certain structural change, probably interstitial effusion, that can be relieved only by a free secretion from the inflamed membrane. Expectoration is a necessary process during the remainder of the disease, and the strength should be saved for this purpose. In many cases, the local is preferable to the general abstraction of blood; and often they may be combined with advantage. The local abstraction of blood should be performed on the side in which auscultation discovers the greatest obstruction to the passage of the air.

In the earliest stage of the disease, the exhibition of a brisk purgative, containing calomel, is useful in assisting the antiphlogistic effect of the bleeding; but at a later period, strong purgatives do not act so favourably, and seem in some degree to check expectoration; a mild mercurial aperient every night is, however, generally useful.

To aid the antiphlogistic measures already named, certain internal medicines, which act especially on the vascular system, are of considerable efficacy. Tartarized antimony, in doses of from one-eighth to one-half of a grain every three, four, or six hours, with a drop or two of hydrocyanic acid, ten or fifteen drops of tincture of digitalis, or twenty drops of colchicum wine in camphor julep or other more agreeable vehicle, greatly contribute to reduce the intensity of the mucous inflammation, and to hasten its termination by expectoration. The efficacy of tartarized antimony in bronchial inflammation is much insisted on by Cheyne, Badham, Stokes, and others. If the cough is very hard and harassing, and is not sufficiently allayed by the remedies just named, it may be expedient to add something to diminish the nervous sensibility, such as hyoscyamus, conium, or belladonna. These drugs produce little effect, unless given in pretty large doses. Opium and the salts of morphia are not well suited to the early stage of bronchitis, as they tend to check expectoration. This objection does not, however, apply to the combination of opium with calomel, which is so efficacious in various inflammatory diseases. We have not found it equal to tartarized antimony, as a remedy for acute sthenic bronchitis; but it is a valuable resource where the latter disagrees on account of irritability of the stomach or great debility, and is more eligible where the bronchial affection is complicated with hepatic congestion and intestinal disorder. From one to three grains of calomel, or double that quantity of blue pill, or Hydrargyrum cum Cretâ, with from one-fourth to one-half of a grain of opium, and a grain or two of ipecacuanha, every three, four, or six hours, according to the symptoms, may in such cases be substituted for the liquid remedies; using, in addi-

tion, merely a little mucilaginous mixture, or some mild slightly alkaline linctus, for the cough, in which, if there be fever, a few grains of nitre and citrate of potass may be dissolved. The mercury may be withdrawn as soon as the gums show signs of its having affected the system, or it may be confined to a single dose at bed-time.

Blisters are not eligible for the early stage of sthenic bronchitis from their liability to excite the whole vascular system before they rise, and consequently to increase the fever and bronchial inflammation. This effect is less likely to be produced by the tartar emetic applied externally, the operation of which, by particular management, may be so hastened as to be made available in acute diseases. For this purpose, the vessels of the surface should be excited by friction with a coarse flannel or a flesh brush, or by the application of cloths rinsed out of hot water, or by a short application of a mustard poultice. The tartar emetic should then be immediately rubbed in, either in the form of a warm saturated aqueous solution, or in that of an ointment composed of one part of tartar emetic and two or three of lard; and the application may be repeated in an hour, if a strong effect is desired. In this way, a full pustular eruption may generally be excited in as short a time as that required for the rising of a blister. We have often seen produced, in two hours, an intense exanthematous redness, which in another hour or two became a thick crop of pimples, speedily running into vesicles and pustules. This form of counter-irritation is more intense and lasting than that from a blister, and is especially suited to give relief in the more sthenic form of bronchitis with very viscid expectoration. It is probable that a minute quantity of the antimony enters the circulation, for nausea is sometimes felt; this result, instead of proving injurious, may be highly salutary.

When free secretion from the bronchial tubes has been fully established, and especially if it be more or less opaque, we may venture on remedies which are hazardous at the onset of the inflammation,—blisters and expectorants, even of a somewhat stimulating kind. The propriety of this change in the treatment has been ably pointed out by Dr. Stokes. Expectoration now becomes the chief mode of relief; and to facilitate this, the decoction of senega, with acetate or muriate of ammonia and tincture of squills, may be added to the tartar-etic or ipecacuanha mixture before in use. Should a state of collapse come on, or symptoms of increasing debility threaten inability to expectorate, it is necessary to resort to more decided stimulants. Of these, the carbonate of ammonia is the most appropriate, as it rapidly enters the system, and seems peculiarly to assist expectoration. It may be given in doses of from two to five grains in decoction of senega, as frequently as the urgency of the symptoms indicate; and it should be withdrawn if there be a return of hardness of the pulse, or heat of skin. The tincture of the lobelia inflata may sometimes be advantageously added, in the dose of ten or twenty minims; but its action is uncertain, both in kind and in degree.

The good effects of the treatment will be apparent in the general symptoms, before they are evinced by the physical signs. The breathing becomes less laboured, the countenance improves, the pulse becomes more steady and full. On observing and listening to the chest, we may perhaps find that the air enters more freely into the lungs; but the mucous and other rhonchi are still present, and continue for some time; and it is only when the improvement is considerable, that we perceive that they diminish, and that the obstructions become less general; that, instead of bubbling over the whole, or a considerable portion of the chest, the respiratory murmur is heard, still mixed with clicking, whistling, and humming sounds.

In the *asthenic* form of bronchitis, the antiphlogistic treatment can be employed only to a limited extent; and the measures for the after stages of the sthenic disease may be used from the first. Blood-letting is scarcely borne, or only by leeches and moderate cupping. Dry cupping is occasionally useful; but the most available external remedies are blisters, which should be of large size. The mercurial or antimonial remedies, used in moderation, together with decoction of

senega, an ammoniacal salt, squill, and compound camphor tincture, constitute the chief internal remedies useful in such a case. Where the depression is great, and the power of expectoration fails, besides the carbonate of ammonia it may be necessary to give other stimulants, such as æther, brandy, or hot coffee. In these cases, likewise, a certain degree of abstinence from liquids is expedient, not only by diminishing the mass of blood that has to pass through the clogged lungs, but also, as in acute catarrh, by reducing the quantity of the bronchial secretion. Dr. Badham recommends assafoetida in the occasional aggravations of the dyspnoea, which he supposes to arise from a temporary spasm in the bronchi. The asthenic form of bronchitis often leaves great weakness; and it is generally necessary to use tonics. If an irritable cough remain, it may be allayed by opium. Change of air will sometimes answer both purposes.

In the bronchitis of young children, emetics and mercurial purges are peculiarly serviceable. The former must not be too frequently used, as they cause considerable determination to the head, and exhaustion; but they are eminently successful in emptying the bronchial tubes of their secretion; and they probably do this, not only by the action of the external muscles of respiration, but also by exciting the bronchial muscles to contract, as we know that the glottis is forcibly closed during the act of vomiting.

It is generally necessary to be particularly energetic in the treatment of bronchitis supervening on suppressed discharges and eruptions. Extensive counter-irritation with tartar emetic is especially indicated in these cases.

In case of retrocedent gout, means should be taken to bring back the inflammation to the extremities, by hot pediluvia and mustard poultices; but these measures alone are not to be depended on; and it is proper to use colchicum with other internal medicines.

The bronchial affections occurring in the course of continued fever, are often rather congestive than inflammatory; and although they may greatly embarrass the breathing, the depressing tendency of the general disease prevents the employment of blood-letting to any extent. Leeches to the chest may be used in the early stages; but subsequently, when the low fever requires wine and other stimuli, the chest affection can only be treated with dry cupping, sinapisms, and blisters, and with moderate doses of tartarized antimony, or of mercurials, according to the symptoms.

CHRONIC BRONCHITIS.

Before entering on the consideration of chronic bronchitis, we shall make a few general observations on chronic inflammation of the air-passages. These are not separated from the acute by any very distinct line; although, when well marked, they differ much from each other. The two forms may pass gradually into each other, and are often conjoined; for although acute bronchitis frequently exists alone, chronic bronchitis is rarely free from an admixture of acute inflammation. Neither is the long duration of the disease always a proof that it is not acute; for, in some cases, attack may succeed attack for weeks and even months, yet never lose the acute character. The character of the expectoration gives some proofs of the state of the membrane; and by its heterogeneous nature in chronic bronchitis, we may form a notion of the different pathological conditions simultaneously affecting the bronchial tubes in different parts of the lung. Perhaps the best test of the existence of chronic inflammation is that proposed by Andral—the continued presence of opaque matter in the expectoration, such as we have classed under the head of *albuminous*, whether it be muco-purulent, purulent, fibrinous, or caseous; whether these occur separately, or, as is more usual, are variously combined, of different degrees of consistence and colour, and occasionally mixed with a thinner and more transparent liquid of a mucous or serous quality.

The catarrhal inflammation of the nasal passages does not often present itself

in a chronic form. If it continue, it loses the character of inflammation, and rather tends to become a kind of gleet or pituitous discharge,—a disease of secretion, coming on at intervals under the influence of various constitutional causes, in the manner of pituitous catarrh, which we shall afterwards describe. Sometimes we find persons complaining of an habitual stuffing or cold in the head, occasionally accompanied by a discharge of a sanious or puriform fluid; and, on inspecting the nostrils, the membrane is found red and thickened; but generally there is something to keep up this irritation, such as polypous growths or small ulcerations, which render the affection distinct from catarrhal inflammation, although it may occasionally originate in repeated attacks of this complaint. When the discharge has a fetid odour, it falls under the description of the disease called *ozæna*. This is, however, more commonly of specific origin, frequently depending on ulcerations, or changes in the membrane of a syphilitic or herpetic character, from which, together with the continued action of the air, the fetor of the discharge probably arises. In young children, the coryzal inflammation shows more tendency to become chronic. It generally terminates in the formation of a thick sulphur-coloured mucus, which may continue for a considerable time, now and then becoming more liquid, and either glairy or puriform. In infants, this complaint often causes great inconvenience and mischief, by interfering with the process of sucking.

The slighter forms of chronic bronchitis is indicated only by habitual cough and expectoration, which are increased by sudden changes of the weather, and generally prevails most in winter and spring. It is most common in advanced life; in fact, few old people are perfectly free from it: in its slighter degrees, it may continue for many years, without materially injuring the constitution of the patient.

The more severe forms may succeed to an attack of acute bronchitis, which has lasted long enough to injure permanently the vessels of the bronchial membrane, its effects not having been controlled by treatment, or various causes having kept up a local irritation at the stage in which the membrane was relieving itself by an unusual secretion. In such cases, although the sputa have become partially opaque and clotted (or *concocted*, as the old writers termed it,) and the unusual mitigation of the fever and other symptoms have accompanied this change, yet the complaint then becomes stationary, with a lower febrile and inflammatory character, but with unsubsided and more paroxysmal cough, often with dyspnoea, soreness, tightness, and wandering pains in the chest, and more or less derangement of the general health. The sputa become diffuent, or of different degrees of consistence, and mixed with opaque clots of a yellowish or greenish colour, often with decided pus; sometimes they are streaked with blood, or of a dirty gray or brown colour, and partially-transparent. When the expectoration is purulent and copious, there is usually much prostration of strength, and some loss of flesh; in some instances, with evening hectic, night-sweats, and other symptoms resembling those of pulmonary consumption,—but the physical signs are wanting. The chest, in simple chronic bronchitis, still expands equally, and sounds well on percussion: the respiration and cough are heard with various rhonchi,—mucous, sonorous, sibilant, and clicking,—which are continually shifting and changing. There is no bronchial or cavernous respiration; no permanent absence of respiration in a part; no unusual resonance of the voice; and, in spite of the continuance of the copious and puriform expectoration, on listening day after day, there are found no signs of a cavity, viz., cavernous rhonchus or pectoriloquy. Under these circumstances, whatever be the general symptoms, it may be pretty confidently pronounced that the disease is not tuberculous consumption, but simple chronic bronchitis. It is not, however, always very easy to get this perfect degree of negative evidence; and it requires much experience in auscultation, as well as repeated examinations, to pronounce confidently the diagnosis. In such and all doubtful cases, we should take also into consideration the history of the attack, the constitution of the patient, and such of the general symptoms as

may serve to throw light on the prevailing tendencies of the system. The more profuse the expectoration, particularly if it be very purulent or otherwise albuminous, the less likely is the case to be one of phthisis, if no signs of this disease be found; and it may be the more readily inferred, that the sputa only proceed from a diseased membrane. But there may be another charge induced, in consequence of long-continued inflammation of the bronchi, namely, dilatation; and this may produce physical signs, which may imitate those of phthisis.

Causes. Chronic bronchitis commonly arises from long-continued or repeated attacks of the acute disease, in the way already mentioned; but in old persons it may originate without any distinct prior acute attack.

An inveterate and formidable kind of chronic bronchitis is excited by the habitual inhalation of air loaded with dust. Needle-pointers, stone-cutters, those who powder and sift the materials for making porcelain, leather-dressers, and workers in artificial hair and feathers, are particularly liable to this affection. In these cases it begins with dyspnœa, which may continue for a considerable time before the disease declares itself. In the course of a few months, however, the dyspnœa is increased, and accompanied by severe cough and copious expectoration, sometimes mixed with pus and blood. Not unfrequently the cough is accompanied with a profuse hæmoptysis. At this time the constitution suffers much: the pulse becomes quick; thirst and fever come on; the tongue is loaded; and the dyspnœa is more and more urgent, often attacking in paroxysms, attended by swelling and lividity of the face. The lesions in these cases, although beginning as chronic bronchitis, generally affect the structure of the air-tubes and pulmonary tissue, and terminate ultimately in various forms of pulmonary consumption. Unless the disease be early relieved by remedies, and a total abandonment of the unhealthy occupation, they become worse; the expectoration increases to a great extent, and becomes more purulent; hectic, with night-sweats, succeeds; and the patient ultimately dies with most of the symptoms of tubercular phthisis.

When chronic bronchitis occurs in early life, it generally follows whooping-cough, measles, small-pox, or some cutaneous eruption, and does not often succeed to the acute disease. It is generally a serious affection in young subjects, and is probably always accompanied or followed by considerable changes of structure in the bronchial tubes.

Anatomical characters. The mucous membrane of the air-tubes is frequently found of a deep red colour, which is either diffused or in patches, and of a more livid or violet tint than in the acute disease. Not unfrequently, however, there is very little redness: sometimes the membrane is even paler than usual; and this, in cases where there has been copious purulent expectoration. It is often thickened, particularly at the branching of the tubes, and the longitudinal and circular fibres under it irregularly enlarged in the manner to be afterwards described. Ulceration is not common in the smaller bronchi, except in cases of the disease arising from the habitual inhalation of dust, in which the whole mucous membrane of the air-passages is both ulcerated and thickened to a greater degree than in any other case.

Prognosis. The prognosis in chronic bronchitis depends very much on its origin, and on its being complicated or not with other disorders. When succeeding to an acute attack, and when unattended with much derangement of the general functions, it does not tend to a fatal termination. Even should there be purulent expectoration and some signs of hectic, a strong constitution and favourable circumstances often bring about a cure; and slighter forms of the disease, though obstinate and lasting for years, seem scarcely to abridge life. But in its worst character, with constant dyspnœa, copious purulent expectoration, hectic, and emaciation, especially if attended with symptoms of confirmed disease in the abdominal mucous membrane, in the liver, or in the heart, it is nearly as fatal as tubercular phthisis. In complicated cases, the bronchitis is often secondary; and there are abundant examples which prove that it may disappear entirely, if the

primary disease be of a tractable nature and yield to treatment. In many instances, the prognosis must in great measure depend on the physical signs: the disease is itself an attendant on phthisis; and if these give the least suspicion that tubercles are present, the case must be considered of doubtful issue. The cases of simple bronchitis that prove fatal, are those in which the mucous membrane and other structures of the tubes have become so altered in texture and function, that the oxygenation of the blood is permanently impeded, whilst the copious secretion, and the perpetual wearing efforts to expectorate it, waste the body and reduce the strength. Such cases generally occur in aged persons, and in those already reduced by fever or some other severe disease. The imperfect oxygenation of the blood that results from extensive chronic bronchitis, occasions congestions in the lungs and heart: hence organic diseases of the heart, with effusions of serum and of blood, not unfrequently supervene on its long continuance.

Treatment of Chronic Bronchitis. In the administration of remedies in this, as in all chronic diseases, regard must be paid to the time required for the cure, and the strength economized accordingly. Unless in case of a temporary increase of pulmonary congestion or aggravation of the inflammation, blood-letting is not necessary, for it has little power to control the action of vessels under the influence of chronic inflammation. Where needful, a few leeches under the clavicles, to the top of the sternum, or cupping between the shoulders, will generally suffice; or the existence of pain on either side may direct the place for blood-letting. The most generally useful class of remedies are counter-irritants conjoined with mild alterative tonics. Friction of the chest with an oily liniment containing various proportions of tartar-emetic, tincture of cantharides, the essential oils, ammonia, or acetic acid, or a diluted mineral acid, according to the effect desired, or a succession of mild blisters; or, in less severe cases, wearing an ample pitch or mercurial plaster, with a small portion of cantharides in it, will furnish a choice of means applicable to every case. The methods by friction are preferable to the use of plasters, for they tend to promote the respiratory movements; whereas, plasters, unless they be supple and carefully applied, may somewhat restrain the expansion of the chest. To avoid this, the patient should be desired to take long deep inspirations when the plaster is first applied; and if its material be rigid, long cuts should be made in it, from the middle to the margin, corresponding with the intercostal spaces from the sternum to the sides. Dr. Stokes strongly recommends the following liniment as a rubefacient in chronic bronchitis:—*R* Sp. Terebinth. ʒij; Acid. Acetici ʒss; Vitellum Ovi j; Aq. Rosæ ʒiiss; Olei Limonis ʒj. We have used it with good effect; but have found a combination of ammonia with similar ingredients a still more permanent and energetic counter-irritant, such as the following:—*R* Liquoris Ammoniacæ ʒss ad ʒj; Olei Amygdal. ʒss; Olei Terebinth. ʒiss; Aquæ Font. ʒij; Olei Rosmarin. vel Limovis ʒj. M. We have sometimes employed with benefit a counter-irritant lotion, composed of a saturated solution of tartarized antimony with hydriodate of potash, in the proportion of half a drachm to the ounce, adding a little oil of turpentine or lemon to distinguish it as a liniment.

With external counter-irritation it is generally expedient to join such internal remedies as may seem best calculated to improve the condition of the diseased membrane, and of the functions generally. These must vary in different individuals; and although, in all these cases, the same local disease—chronic bronchitis—exists, yet they may be relieved by the most opposite means. Mild tonics, such as calumba and cascarilla with nitric acid, sarsaparilla, and taraxicum, are very commonly useful to improve the state of the secretions and functions in general; and where the expectoration is profuse and even purulent, without much vascular excitement, the mineral acids and metallic astringents in some cases, in others myrrh, copaiba, the balsam of Peru, or benzoic acid, prove occasionally useful. Many of these are safe and beneficial only when combined with external counter-irritation. With this safeguard, we have found that even steel medicines, parti-

cularly that most valuable preparation, the iodide of iron, may be borne, and have sometimes been very salutary in improving the general health and strength, without increasing the cough. The hydriodate of potash has been also found of service in some instances: it seems to restrain low degrees of inflammation affecting the fibrous parts of the air-tubes, and probably may, in some degree, retard the processes of induration to which they tend.

Of late years much has been said for and against the direct application of remedies to the bronchial surface, particularly of the vapour of iodine and chlorine by inhalation. This treatment, proposed some years ago by M. Gannal, a French chemist, has been used with some advantage by several practitioners. The chlorine or iodine is put in a liquid state into an inhaler containing hot water, and the air drawn into the lungs through a thin layer of this water is impregnated with an amount of chlorine varying according to the proportion of the ingredients used. In several cases in which we have seen this plan tried, the result has been unfavourable, the stimulating properties of the vapour exciting fever and cough, and the effort of inhaling fatiguing the patient. For this method of inhalation might be substituted the diffusion of iodine or chlorine combined with aqueous vapour, either in the apartment of the patient, or, what would be more practicable, in a small room or closet, cleared for the purpose, in which half an hour or an hour could be spent twice a-day. This plan has been also proposed by Dr. Murray. Iodine or chlorine may be readily dispersed in any quantity through a room, by placing a few grains of the former, or a solution of the chloride of lime or soda, in a saucer floating on hot water. The quantity should be determined by the effect on the patient, always keeping it below that which causes much coughing or acceleration of the pulse. The inhalation of tar vapour has had repeated and extensive trials, since Sir Alexander Crichton first directed the attention of practitioners to it, and there has been some evidence in favour of its beneficial effects in certain cases of chronic bronchitis. As it is of a stimulating nature, like the balsams, it proves useful only in cases free from irritability or tendency to active inflammation: it is important to watch its effects when first employed, and to diminish or withdraw it altogether, if it continue to aggravate the cough and quicken the circulation.

The utility of expectorants in the chronic form of bronchitis has been questioned, because it is supposed that they might increase the secretion that is already redundant. But they probably exert, in many instances, an alterative rather than a stimulant operation on the bronchial membrane. Thus ipecacuanha, which seems to increase the expectoration in acute bronchitis, modifies and facilitates it in the chronic disease. In some cases, it may be given with great advantage in emetic doses repeated every two or three days: in some obstinate examples of the milder form of the disease attacking persons of robust habit, this practice has effected a cure. As an expectorant, it may be given in the dose of a grain or two of the powder or twenty or thirty drops of the wine, repeated several times a-day, combined with squill, colchicum, camphor, and opium, or any other combination that the symptoms of the case may indicate. Squill is very useful in chronic cough unattended with purulent expectoration; and, in combination with colchicum, ipecacuanha, and a small quantity of opium, is often very serviceable in facilitating the expectoration and quieting the winter cough of old people. When the expectoration is viscid, an alkali should be added; and with a feeble state of the circulation, the carbonate of ammonia is the best. The tincture of the lobelia inflata has sometimes proved very beneficial in the occasional aggravations of chronic bronchitis, by relieving the breathing, and facilitating expectoration; but its operation varies greatly, sometimes causing giddiness and faintness in a dose of ten minims, sometimes giving relief only in doses of a drachm.

To diminish morbid sensibility, and allay that mobility of the muscular system on which the length and frequency of the fits of coughing depend, narcotics must often be combined with the preceding remedies. Unless for the sake of procuring a night's rest, opium should not be given alone, but combined with

ipæcuanha, colchicum, or some of the other drugs which in some measure prevent its astringent effect on the secretions. The salts of morphia, *liquor morphiæ bimeconatis*, or the Tinct. Camphoræ Co., are in many cases more suitable than solid opium or its tincture. Conium in its extract is a very useful narcotic in chronic bronchitis, particularly combined with ipæcuanha, and, if the secretion be excessive, with benzoic acid also. The extract or tincture of conium has been sometimes used by inhalation: Dr. Stokes recommends ten or fifteen grains of the extract to be added to hot water in an inhaler, and the inhalation practised for a quarter of an hour once or twice a-day. The extract or tincture of henbane, and the extracts of stramonium and of belladonna, are likewise occasionally beneficial. The latter is particularly serviceable where the cough has a convulsive character: and it should be given in large doses, such as a grain or two. In these convulsive cases, assafœtida and valerian have been found very serviceable. Hydrocyanic acid, the oil of bitter almonds, and laurel-water, which seem to owe their power to the same principle, also sometimes give great relief to the cough of nervous subjects; but we have found them very uncertain.

Besides the means directed against the bronchial disease, it is of great importance to attend to the state of the functions in general. In febrile cases, the daily exhibition of a saline purgative is advisable. Should there be any complication with abdominal disorder, it is obvious that this should be attended to. Thus, when pain of the right side and shoulder, with perhaps fulness and tenderness in the right hypochondrium, stools of unnatural colour, a loaded tongue, and turbid urine, indicate disordered function of the liver and alimentary canal, it will be desirable to put the patient under an alterative course of blue pill and mild aperient medicines, in order to improve the functions of these important organs. Again, where a florid tongue, tender epigastrium, frequent thirst, dry skin, and nightly accessions of fever, indicate that the disease extends to the mucous membrane of the stomach and bowels, it is quite apparent that many of the remedies directed against the bronchial disease will not be borne, or will prove injurious, until the gastric disease be relieved by leeches and blisters to the epigastrium, followed by the mildest alterative aperients, with small doses of castor oil, and rigid regulation of the diet. Until this gastritic affection be subdued, the action of most internal remedies, even colchicum or opium, may be irritating. If due attention be paid to the removal of such complications, and if the disease do not present a decidedly inflammatory character, the weakness of the system may be combated by tonics, such as the sulphate of quinine, and the others before named.

Diet and regimen. The diet, in all cases of chronic bronchitis, should be mild and simple, and as nourishing as can be borne without disordering the digestive organs, or increasing the bronchial disorder. Farinaceous and milky food, with a little chicken or white fish, is best adapted to the plurality of cases; but those whose frames have been much weakened by age or by excesses generally require more substantial animal food, with a certain proportion of wine, which, like tonics, may be allowed with most safety where a counter-irritant is habitually used. It is scarcely necessary to insist on the importance of avoiding extremes and sudden changes of temperature, insufficient or damp clothing, and all those circumstances that are frequently in themselves exciting causes of the disease: when reapplied, they must necessarily prolong it; and not a few instances are met with, in which, owing to the nature of our climate, it is impossible entirely to avoid them. In these cases, in spite of the most careful administration of remedies, the disease persists; but a perfect cure may be effected by simple removal to a more genial climate. A warm sea-coast residence is the most beneficial, especially if the patient use regular and moderate exercise in the open air. When the circumstances of the patient do not permit the measure to its full extent, a change of air to the distance of a few miles may often do good, always preferring a sheltered situation with a dry soil. The careful regulation of the air in the apartments to which he is confined during the winter months, must be

the resource of many in this country; and this can now be effected with the greatest precision and economy by means of Dr. Arnott's stove, one of the most valuable inventions of the present age. There must, however, be additional means to ensure the ventilation of the rooms, which may be safely effected by a small fan-wheel in a window or door, so placed as to direct the current of fresh air to the ceiling, where it would mix with the warm air of the room, and occasion no draft.

In those predisposed to bronchial inflammation, the practice of daily sponging the chest freely with vinegar, or salt and water, contributes much to diminish the susceptibility to cold; and in the winter, the chest should be well-protected by a leather vest, as well as a long-sleeved flannel waistcoat.

BRONCHORRHŒA.

Symptoms, general and physical.—Causes.—Hay-asthma.—Anatomical characters.—Prognosis.—Treatment.

THE mucous membrane of the air-tubes may be disordered in its function of secretion, independently of the process of inflammation; and, by the effects of the altered secretion as well as by the condition of the membrane itself, various groups of symptoms are induced. The most remarkable are those accompanied by excess and defect of the watery part of the secretion, constituting *Bronchorrhœa*, or *Bronchial flux*. That with excess is the *Humoral Asthma* of the older writers, and the *Pituitous Catarrh* of Laennec.

Symptoms. Bronchorrhœa generally comes on without any fever, in paroxysms of asthmatic or oppressed breathing, with cough, and the subsequent expectoration of an abundant thin frothy liquid, which appears to be the natural mucus diluted with a considerable addition of the watery part of the blood, with some portion of its saline matter. In some instances the affection extends to the nasal membrane, causing sneezing and a discharge from the nostrils, similar to that of a cold in the head; sometimes the bronchial and nasal affections alternate. The attack generally comes on rather suddenly in the evening, sometimes twice or oftener in the day, and may last from a few minutes to several hours: the dyspnœa is sometimes extreme; but the strength of the respiratory forces being unimpaired, the fluid is discharged by violent coughing as fast as it is secreted, and comes up clear, slightly viscid, and frothy, to the amount of a pint or more leaving the patient almost free from complaint. On applying the ear to the chest at the commencement of the attack, various kinds of whistling, cooing, and sonorous rhonchi are heard; a little later, these become mucous and crackling or bubbling, and very little of the natural respiratory murmur is heard. The sound on percussion is generally pretty good; but in severe cases this is also impaired by the profuse quantity of liquid, which from the sub-mucous and sub-crepitant rhonchi may be known to extend even to the smaller bronchial tubes. As the coughing discharges this fluid, the respiratory murmur gradually returns; but even after the paroxysm is over, a good deal of whistling and wheezing may be heard in the chest.

Causes. This affection commonly occurs in persons of a relaxed habit, who have a languid circulation and are little disposed to inflammation. It appears to be frequently connected with long-standing disorder of the digestive or biliary organs. Laennec remarks that it is common in gouty subjects advanced in age, in whom the gout has become irregular and slight in its effects on the extremities. The causes which generally excite an attack are, exposure to sudden transitions of temperature, especially when the body is perspiring, disorders of the

stomach and bowels, particularly from acid or accecent drinks, and other circumstances that tend to disorder the balance of the secretions and of the circulation. It sometimes arises from the unknown atmospheric influences, which develop common catarrh or bronchial influenza: in these diseases the pituitous catarrh often forms a most prominent and important pathological part, and it may remain after the febrile symptoms have subsided.

The *summer catarrh*, *hay-fever*, or *hay-asthma*, as it is termed from its supposed connexion with the effluvium of new hay, commonly presents the features of pituitous catarrh in the periodical and intermittent character of its attack. After one attack, pituitous catarrh is very apt to recur; very slight causes, such as peculiar odours, close rooms, and trivial irregularities of diet being sufficient to re-excite it. In many cases however—from our own experience we should say in a considerable majority—bronchorrhœal discharges are secondary on organic disease of the heart, tubercles of the lungs, or some other organic lesion, causing obstruction in the circulation through the lungs, the flux being a natural mode of relief to the over-distended vessels. Not unfrequently it accompanies or follows dry catarrh or bronchial congestion; and we shall presently find that the pathological difference between the two affections is not great.

Anatomical characters. The examination of the air-tubes of those who have died during a paroxysm of pituitous catarrh, discovers little or no trace of inflammation in the bronchial membrane. It is sometimes a little thickened and softer than natural, from the infiltration of serum; sometimes it is perfectly pale; sometimes a few lines or patches of vascularity are seen. The heart is commonly found more or less diseased, especially at the left auriculo-ventricular orifice; sometimes there is merely thinning of the walls. More rarely miliary tubercles are found in great abundance; and we have seen an instance of pituitous catarrh in connexion with malignant disease of the bronchial glands, which seemed to press on several of the great pulmonary blood-vessels. These several results, together with the transitory character, but long-continued recurrence of these attacks, the nature of the discharge, the absence of febrile and inflammatory symptoms in the subjects whom it affects, lead us to consider pituitous catarrh as a *profluvium* depending on a laxity, want of tone, or a mechanical obstruction of the pulmonary and bronchial vessels, rather than on an inflammation.

Prognosis. The importance of this affection varies much according to the state of the individual. When it attacks a subject enfeebled by age or disease, it may prove fatal in a few hours, there not being sufficient strength to discharge the suffocating accumulation of fluid in the air-tubes. Again, its long continuance, when it has by habit become established in the system, may waste the body, and by the struggle caused by its frequent attacks it may aggravate or induce disease of the heart, and lead to dropsical effusions and other serious symptoms of a breaking-up of the constitution. In other cases where the body is strong, or the disease slight, it may go on for years, impairing the comfort rather than destroying the general health of the individual. Its occasional occurrence may even prove salutary in cases of diseased heart, by unloading the engorged pulmonary vessels, and averting more formidable evils. Andral records an instance in which a sudden temporary attack of pituitous catarrh with very profuse discharge was attended with the removal of hydro-thorax. In all cases the condition of the general health and of other organs, especially the heart and lungs, must be duly considered before a prognostic of the probable issue of the case can be safely given; and if there be found by physical examination that there is considerable disease of the heart, or a probability of the presence of tubercles in the lungs, the case will assume a proportionately unfavourable aspect.

Treatment. This affection is sometimes very obstinate, particularly when it has become established in the habit. The treatment should be considered in relation to the attacks of dyspnoea and expectoration, and to the condition of the system, and the pulmonary and general circulation, with a view to prevent the recurrence of the attacks. The chief indication, when an attack comes on, is to

shorten its duration by diminishing the pulmonary congestion as far as possible by means of derivatives, and promoting the relief of what remains by measures which assist expectoration. From what we have already said of the nature and subjects of the disease, it may be inferred that blood-letting is rarely indicated. Immersing the hands and feet or even the whole body in hot water, or still better in a vapour bath, will sometimes, by deriving freely to the surface, much relieve the paroxysm of dyspnœa, and diminish the quantity of secretion which accompanies it; but to take effect, such measures should be employed at the earliest feeling of the asthmatic attack, and before the secretion commences, otherwise they only weaken the patient and scarcely shorten the attack. An emetic will often relieve an attack by determining freely to the surface, and by facilitating the discharge of any fluid which may have already been secreted in the air-tubes; and some cases have been signally benefited by the repeated use of this remedy. Its violent and disagreeable action, however, precludes its employment in many cases; particularly in the weakly, and those labouring under organic affections of the heart. Laennec found tartar-emetic in large doses effectual in two cases in which suffocation was threatened. Ipecacuanha is however on the whole preferable, and when it cannot be borne as an emetic, it is sometimes useful in equalizing the circulation and in promoting expectoration and perspiration. When the cough is very violent, it may be advantageously combined with hyoseyamus, conium, or small quantities of opium. In a few cases we have known great relief from the tincture of the *lobelia inflata*, in the dose of from twenty to thirty drops every hour or two hours, and increased according to its effects; but it is a very uncertain remedy, sometimes causing a most unpleasant giddiness and sickness in the dose of ten drops. In subjects that are very weak, with languid circulation, it may be necessary to give stimulants to support the powers of expectoration during the paroxysm. Of these, strong hot infusion of coffee is the best and the most harmless, but it is apt to lose its effect; and it may be requisite to substitute combinations of ether, ammonia, and camphor, with one of the remedies before named.

The most important object of the treatment is to prevent the recurrence of the attacks; and for this purpose constitutional measures are of more avail than those directed particularly to the lungs. Of the latter it may however be mentioned, that the habitual promotion of moderate expectoration by small doses of ipecacuanha and the balsam of copaiba or Peru, with alkaline attenuants and other remedies, recommended for bronchial congestion, may sometimes prevent that accumulation in the vessels that is apt to end in an asthmatic paroxysm. The occasional application of a blister will sometimes withdraw the irritation and flux from the bronchial surface. A course of aperients may also give temporary relief, particularly where the complaint originates in a torpid state of the bowels; but drastic purgatives should be avoided, for although they may for the time remove the pulmonary symptoms, they injure the tone of the digestive organs and ensure the recurrence of disorder. In gouty subjects it is useful to increase the urinary secretion by a moderate use of colchicum with alkalies. But these measures are of little avail, unless attempts be made to improve the tone and balance of the vascular system by a mild but tonic diet and regimen. The diet should be mild and nutritive, consisting chiefly of farinaceous food and plain meat taken at regular hours and in moderate quantity. Spirituous and fermented liquors should be taken as sparingly as the previous habits of the patient and the present strength will allow. Liquids of all kinds should be used with limitation, and with due regard to the activity of the renal and cutaneous excretions. These should be promoted by regular exercise in a bracing but not a too cold air, care always being taken that the clothing is sufficient to maintain the temperature of the surface. Such measures will generally do more than drugs; but where they prove insufficient or cannot be fully adopted, benefit may sometimes be derived from a course of some mild tonic, such as columbo, cascarilla, or even quinine with a mineral acid, or the sulphate of zinc in small doses, or one of the milder preparations of steel.

In cases of hay-asthma, Dr. Elliotson recommends the diffusion of chlorine in the air of the patient's apartment, by placing in it saucers, &c., containing chlorides of lime or soda. In three out of four cases, this measure afforded signal relief.

BRONCHIAL CONGESTION.

Its symptoms and physical signs.—Causes.—Anatomical character.—Prognosis.—Treatment.

BRONCHIAL CONGESTION, or *congestive asthma*, inaccurately termed by Laennec *dry catarrh*, is another affection which exemplifies altered secretion of the bronchial membrane without inflammation. It is known more as an asthmatic than as a catarrhal affection.

The *symptoms* vary much according to its extent. In its slightest degrees it is experienced by many individuals, who only in the morning on waking feel their breath rather short until they have coughed up a little thick, tough, gray semi-transparent or dirty-looking mucus. In its severer degrees, that is, when more of the bronchial membrane is affected, the shortness of breath may amount to asthma, which comes on in paroxysms ending with hard dry cough and the expectoration of the scanty mucus before mentioned. Occasionally there may be also a thin mucous secretion: but this is not constant, and is obviously not the general cause of the dyspnœa. Sometimes there is little or no cough; and the dyspnœa or rather shortness of breath is not in fits, but may last for months and even years without other pectoral symptoms. If an attack of bronchitis supervene, there is a great aggravation of the dyspnœa, often amounting to severe asthma, and the symptoms of the two complaints are conjoined. But in simple bronchial congestion there is no fever, or sign of inflammation, but sometimes a sense of heat and constriction, or rather of stuffing, in the chest. There is often however much gastric disorder, with swelled and slightly furred tongue, relaxed uvula, and congestive tonsils.

The *physical sign* of this disease is a more or less complete suspension of the respiratory sound in the part affected, whilst the chest at that point sounds well on percussion. This suspension is caused by the tumefaction of the bronchial membrane, which either of itself, or assisted by the scanty thick mucus before mentioned, obstructs the passage of the air in ordinary respiration. Sometimes during coughing, or violent efforts of respiration, a clicking, wheezing, or sibilant sound announces that the obstruction is not quite complete; and some of the tubes will generally yield some of these rhonchi in common breathing. These signs, together with the character of the expectoration, will suffice for the diagnosis.

Causes. Excesses in diet, the sudden removal of cutaneous eruptions, suppressed gout, and sudden checks given to perspiration or any other free secretion, occasionally excite this affection. These causes operating on systems not much disposed to inflammatory reaction, such as those of a torpid habit of body, destroy the balance of the capillary system, and occasion an undue distention or congestion in certain parts of it. The same kind of passive congestion is sometimes more directly occasioned by organic diseases of the heart, particularly those in which there is some obstruction in the left ventricle; and these cases frequently are accompanied by the symptoms of dry catarrh.

Anatomical Character. The membrane of the air-tubes is generally found of a deep red or violet colour, and sometimes partially tumefied, but without softening or ulceration. These circumstances, together with the sudden and intermit-

ting character of the disease in some instances, and its long stationary duration in others, seem to indicate that the affection rather belongs to the class of passive congestions which may be produced and removed, or endure for an uncertain period without that tendency to definite terminations which inflammations manifest. This congestion may doubtless sometimes originate in inflammatory affections of the same part; but according to our experience it is more commonly, as already stated, the result of disorders of the digestive or other organs, which tend to injure the tone of some or other part of the capillary system; and when from prior tendency the bronchial membrane becomes its seat, its secretion is impaired and the symptoms above described are induced. Occasionally bronchial congestion is conjoined with bronchorrhœa: but according to the view which we have taken of that affection, the pathological causes of the two do not very widely differ, the same circumstances which cause a loss of tone in the capillaries being capable of either relaxing their exhalations, or dilating their caliber; or, what is more usually the case, some parts of the membrane are affected with one, and some with the other, and the result is the expectoration of much thin glairy fluid, with little pellets of tough mucus in it. So, too, by a modification in the properties of the congested vessels they may be excited or relaxed, and relieve themselves by the exhalation of their watery contents; and we accordingly sometimes find an attack of catarrh or asthma, at first quite dry, and devoid of any but the tough expectoration, suddenly relieved by a copious discharge of a thin frothy fluid. This happens commonly where the congestion is a mechanical result of organic disease of the heart.

Prognosis. Dry catarrh, although sometimes severe and difficult to remove, is rarely a dangerous disease, except in so far as it may be connected with organic lesions of the heart or extreme general debility. According to the extent of the bronchi affected, the disease varies from a degree not interfering with the general health to one amounting to severe asthma. Andral records two instances in which fatal asphyxia was caused by tough mucus that plugged up one of the great bronchi, and which no efforts of coughing were able to remove; but these are to be considered as accidental cases; and generally the expectoration comes at last, to the temporary relief of the breathing even in the most severe cases. But the continuance of the disease tends to induce permanent lesions of the pulmonary texture, particularly dilatation of the tubes and cells, which tend more constantly to injure the function of respiration, and sometimes eventually to destroy life.

Treatment. Depending, as this affection generally does, on constitutional causes, it requires general treatment as well as measures calculated to improve the condition of the affected membrane. A due management of the diet, avoiding all acid, rich, and irritating articles of food, the promotion and regulation of the excretions by the appropriate combinations of mild aperients and diuretics, such as blue-pill, ipecacuanha, rhubarb, aloes, nitre, colchicum, &c., followed by mild alterative tonic medicines and suitable exercise, are the measures best calculated to restore and maintain that balance and tone of the sanguiferous system, which is incompatible with the congestive distentions of its parts.

With regard to the remedies directed to the congested membrane, it is not found that those useful in bronchitis are of much avail here. Blood-letting produces little impression. Dry cupping and other means of derivation are occasionally of more use. Stimulating applications to the surface of the chest, such as turpentine and vinegar or ammonia embrocations, or pitch plasters, or even dry rubbing, are frequently of temporary advantage. There are however means of increasing the bronchial secretion, and thus reducing the congestion, which, as temporary remedies, have considerable efficacy. We have before noticed the property which alkalies seem to possess, of determining to the bronchial surface; and we have now to notice in addition their attenuant or dissolving power, which diminishes the tenacity of the bronchial secretion, augments its quantity, and thus facilitates its expulsion. Their action is probably in great measure chemical.

We know that alkaline remedies render the urine alkaline, and therefore increase the alkaline quality of the blood. Now there is no solvent of mucus more powerful than alkalies; and it is easy to conceive that an alkaline state of the blood can scarcely be compatible with the formation of tough solid mucus. Having followed the example of Laennec in using this class of remedies, we have found them very beneficial in promoting expectoration, and relieving the dyspnœa of dry catarrh. The *Liquor Potassæ* (℥xx to xl,) carbonate of soda (gr. x to xx,) or carbonate of ammonia (gr. iij to vj,) may be given three or four times a-day, with squill, ipecacuanha, or colchicum, and some narcotic, according to the general state of the system and the prevalence of particular symptoms. Laennec recommended also the use of alkaline baths, and of sulphur baths in cases complicated with cutaneous eruptions. The inhalation of the steam of hot water, alone or with camphor, tar vapour, ammonia, or any other volatile matter which may render it slightly stimulating, is sometimes of use. Some patients derive benefit from smoking tobacco or stramonium, particularly when there is also a tendency to spasm in the bronchi.

SPASMODIC ASTHMA.

Character and history.—Causes.—Diagnosis.—Prognosis.—Treatment.—Atonic or paralytic dyspnœa and its treatment.

THE air-tubes are throughout endowed with nervous and muscular fibres, the functions of which contribute to the due performance of the act of breathing. The amount of the assistance which they thus contribute in health is not well known, but a morbid defect or excess of their operation is the cause of a peculiar class of affections of the respiratory organs of a nervous or spasmodic character, including *Larygismus Stridulus* (Spasms of the Glottis,) which has been already described, *Spasmodic Asthma* and *Atonic or Paralytic Dyspnœa*, *Hooping-cough* and *Neuralgia* or *Morbid Sensibility of the Air-tubes*.

Character and history of asthma. The term *asthma* is generally given to dyspnœa occurring in paroxysms. We have seen that attacks of bronchial congestion and bronchial flux may come on suddenly, last a longer or shorter period, and cease in such a manner as to merit the name of *asthma*; by which in fact they are generally known in this country. In the greater number of cases of asthma, there is reason to suppose that one or other of these affections or some degree of inflammation is present, and, by increasing the irritation or the irritability of the bronchi, causes an undue contraction of their circular fibres. An increased vascularity of the bronchial membrane may heighten its sensibility, and augment the contraction of those fibres that are in relation to it; and the same effect may ensue from the irritation of an unusual quantity or quality of the secretion within these tubes. So on the other hand the continuance of inflammation, the thickened and altered condition which it induces in the membranes, may tend to impair their sensibility, and injure in proportion the contractility of the air-tubes. In all these cases, the modification of the sensibility and contractility of the air-tubes is secondary to other lesions that are more essentially vascular.

But there are also cases of asthma of a purely nervous character; and this is sufficiently pointed out in the temperament of the patient, the nature of the exciting causes, the very sudden attack and removal, and the irregular duration of the affection. Thus it commonly occurs in nervous or hysterical subjects. The attacks are excited by strong or peculiar odours (such as the smell of a stable or of ipeca-

cuanha,) close rooms, sudden changes or particular conditions of the atmosphere, irritations of the stomach, mental emotions, disordered menstruation, and the like. These causes often suddenly bring on an attack, which, if severe, obliges the patient to assume a remarkable and very characteristic attitude. The body is bent forwards, with the arms resting on the knees; the chest is contracted, with the feeling of a tight cord or heavy weight upon it; the face is suffused, accompanied with an expression of great anxiety and distress; the veins are turgid, and the perspiration copious, whilst all the muscles of respiration, ordinary and supplementary, are brought into full action in order to introduce air into the chest.

With what amount of success these efforts of respiration are made, may be known by applying the ear to the chest, where, in spite of the force of the motions, scarcely any sound of passing air is heard. The contractions of the muscles often give an external muscular sound; but within the chest there is only a very faint respiratory murmur, with occasional whistling or wheezing. The violent action of the muscles of inspiration seems to diminish rather than to increase the entrance of air: but when the efforts are less violent, especially towards the end of the paroxysm, now and then the air is heard to enter freely, as if the obstacle were suddenly removed, but at the next breath there is the same obscurity as before. At these temporary returns of the respiratory sound we must suppose that the spasm of the bronchial muscles is for the moment relaxed; and Laennec has pointed out a method of causing at will this relaxation, the consideration of which may be useful in enabling us to discover the nature of the disease. If we desire a patient who labours under the asthmatic spasm to restrain his efforts of breathing, and to hold his breath altogether for a few seconds, or, what amounts to the same thing, to count with his voice as many numbers as he can without taking breath, and then as quietly as possible to breathe again, the air will be heard to enter freely into every part of the lungs, but in a breath or two after the spasm regains its hold, and the respiration becomes as obscure as ever.

Laennec used to say by way of explanation that the spasm was thus overcome by *surprise*; but this expression gives no distinct physiological reason for the phenomenon. It does not seem to be explicable without assuming that there is a temporary relaxation of a tonic spasm of muscular fibres; and this relaxation we would ascribe to an increased degree of the same cause which usually induces the contraction of the same fibres. It is probable that the contraction of the circular fibres of the bronchi, excited by a certain degree of foulness of the air that is within them, is an essential part of natural expiration. Now the foulness of the air being increased by holding the breath long would stimulate these fibres to their utmost contraction, a contraction even beyond that of asthmatic spasm: their irritability is thereby for the moment exhausted, the spasm becomes consequently relaxed, and the air is heard to enter freely; but after a few moments' relaxation, the irritability is again restored, and the exciting cause of the spasm remaining, the next breath may find the contraction as strong as ever.

The distinctive physical sign then of spasmodic asthma is imperfect sound of the respiratory murmur, *except after holding the breath*, when it becomes as loud as, or louder than usual. The bronchial spasm is often of long duration; but it is liable to temporary increase, causing more decided fits of asthma in which the symptoms before described are manifested in the highest degree, and on their subsidence the patient is only short-breathed. When the bronchial spasm is considerable, especially in the paroxysms, the chest may sound ill on percussion, not with the absolutely dull sound produced when solid or liquid occupies the chest, but a short tight sound, like that which the chest yields on a forced expiration. This is caused by the contracted state of the lungs when under the influence of the bronchial spasm; the walls of the chest, therefore, being forced inwards by atmospheric pressure, are not so free to vibrate as usual, when this pressure is more nearly balanced on either side. A better sound may generally be obtained by striking on a finger or pleximeter pressed on the chest strongly enough to exceed the contraction of the lungs. This contraction when

excessive sometimes causes the diaphragm to rise higher than usual in the chest, leaving a remarkable hollow in the epigastrium, and gives to the whole chest a tight and contracted appearance.

We have remarked that those who suffer much from spasmodic asthma are seldom free from a shortness of breathing in the intervals; and the frequent recurrence of the paroxysms generally increases this habitual dyspnœa. If we examine their chests, we find the same diminution of respiratory sound as during the paroxysm, but in a less marked degree; and the test of holding the breath proves that the spasm exists here also, having in a measure become habitual. The frequent recurrence or long continuance of these spasmodic contractions of the tubes must lead to permanent diminution of their caliber, and the other tissues become changed, and fix the tubes in this constricted size. We see the parallel of this in the irritable bladder, which, after long-continued attacks of spasm, at last becomes permanently contracted. Where the disease is purely spasmodic, this more lasting change might not ensue for a very long period; but with the spasm there is so commonly associated, either as cause or effect, congestion, irritation, or inflammation, that the phenomena and effects of these pathological conditions are very commonly combined with those of spasmodic asthma. Thus in asthmatic subjects, an attack of bronchitis, bronchial congestion, or bronchorrhœa, will be attended by spasmodic exacerbations; and a fit of nervous asthma which first comes on suddenly as a spasm, often terminates in a copious catarrhal secretion. The spasmodic constriction of the bronchial tubes, and the consequent violent yet ineffectual respiratory efforts, produce a congested state of the pulmonary vessels and partial obstruction of the circulation, which disorder the action of the heart, and may not be relieved without a free watery discharge from the bronchial membrane. On the other hand, asthmatic paroxysms are frequently associated with organic diseases of the heart. The congestion which these determine in the membranes and structure of the lungs, increases their sensibility and irritability; and where the circular fibres are naturally disposed to spasm, this congestion readily excites it; and the spasm may not be entirely relaxed until the congestion is relieved by free secretion from the bronchial membrane. So, also, irregular gout, or the sudden suppression of an habitual discharge or secretion, or of a cutaneous eruption, may determine an irritation and congestion of the bronchial surface, accompanied by an asthmatic spasm.

Causes. In the preceding sketch of the history and pathology of the disease we have adverted to some of the causes which occasionally excite asthmatic spasm. But when the disease is purely nervous, there must be a condition of the nervous system in general, or of the nerves of respiration in particular, which gives the bronchial muscles unusual irritability. The nature of this condition is involved in much obscurity; but it may be classed with that which gives rise to many spasmodic affections of other muscles, which are called nervous or hysterical, and which not unfrequently occur in the subjects of spasmodic asthma. Hence violent mental emotions, long-continued illness, especially such as in itself or by its treatment tends to depress the tone of the system, menstrual irregularities, and particular states of the atmosphere, are among the circumstances which may pre-dispose to, and even produce, spasmodic asthma; the pre-disposition is in some instances distinctly hereditary. In a few instances, spasmodic asthma has been more satisfactorily traced to a local cause of irritation, such as a tumour pressing on the pulmonary plexus, or on the par vagum, in some part of their course. Probably the remarkable influence which the state of the stomach and digestive organs often exerts on asthmatic affections may be also referred to irritation reflected through these nerves. In some instances too a source of irritation has been found in a diseased state of the upper part of the spine, occasioning pressure on the medulla or on some of those spinal nerves which, communicating with the great sympathetic, are also in relation with the nerves of the lungs.

Diagnosis. The sudden attack and removal of the paroxysms, together with

the assemblage of physical signs before described, constitute the distinctive character of the disease. The slighter tonic or permanent spasm which may remain in the interval, and cause an habitual shortness of breath, may also be known by the respiration becoming distinct, not on increased effort, but after holding the breath, as well by the absence of the signs of other lesions of the lungs or heart. The absence of fever also serves to distinguish it from inflammatory diseases. For spasmodic affections of the larynx, it may be known by the absence of the peculiar hissing or stridulous sound resulting from the passage of the air through the constricted glottis. We have before remarked that bronchial spasm is generally associated with a congested state of the bronchial vessels, ending in secretion; and it therefore rarely happens that during the paroxysm, and especially towards its termination, there are not present also many of the signs of catarrh. So likewise, where the asthma is symptomatic of disease of the heart, the signs of this, and of its various pathological effects, are combined with the asthmatic affection.

Prognosis. Spasmodic asthma, although most distressing and alarming in its attacks, is seldom fatal when uncomplicated with organic disease. It is probable that the spasmodic constriction, although sufficient to cause a painful feeling of suffocation in the lungs, which are perhaps unusually sensitive, always yields before the system can become injured by the imperfect oxygenation of the blood. The view which we have given of the temporary relaxation of the asthmatic spasm favours this supposition, and explains the well-known fact that spasmodic asthma is more distressing than dangerous. But as it is often complicated with other affections of the lungs and heart, or its frequent recurrence may tend to induce them, particularly dilatation of the air-cells, pulmonary congestion and hæmorrhage, dilatation and hypertrophy of the heart, &c., we are not to regard asthma as free from dangerous tendencies. We have known more than one case of hereditary asthma occasionally attacking an individual from the age of childhood to manhood, and terminating at the age of between forty and fifty in pulmonary consumption. In such cases tuberculous disease probably existed in a limited extent from a very early period: the asthmatic spasm occasionally supervening on it, and tending to increase it.

Treatment. This is to be considered in relation to the paroxysm and to the general state of the system in the intervals. The first indication is to counteract the exciting cause of the spasm, the second to remove this cause altogether or to lower the irritability on which it operates. 1. To relax the spasm of the bronchial tubes various measures may avail according to its immediate cause: when this is chiefly nervous, with little bronchitic or catarrhal complication, such antispasmodics as ether, valerian, assafœtida, opium, belladonna, and especially the fumes of stramonium, or tobacco, inhaled into the lungs, will sometimes succeed; each of these has proved more successful than the others in particular cases, but seldom retains its efficacy long. A more generally and permanently successful remedy is strong infusion of coffee, long ago recommended in this country by Pringle, and much extolled by Laennec. We have known some asthmatic patients, who relied so much on its efficacy, that the very idea of being out of the reach of it would be enough to bring on a fit; and they scrupulously avoided using coffee as an ordinary beverage, lest the habit of taking it should impair its efficacy as a remedial agent. This is a good rule, for this remedy is not free from the tendency of antispasmodics and narcotics, in general, to lose their power by frequent exhibition. In most cases it is easier to avert an asthmatic paroxysm than to stop or to shorten it when it has once begun. Hence, after previous experience has indicated the usual times and signs of its approach, the remedies before named may be given with the best advantage in anticipation of the attack. This is especially the case with the smoking of stramonium, which we have often found useful in this way, and rarely so after the fit has begun. In some cases sudden strong impressions on the system, such as dashing pails of cold water on the body, or passing slight electric shocks through it, have been known to stop a fit

of asthma. Strong counter-irritants and revulsives, such as mustard poultices to the epigastrium, hot turpentine fomentations to the chest, and irritant pediluvia, in some cases give relief, but in others aggravate the symptoms. Emetics have the same uncertainty of effect. If the asthmatic spasm be complicated with an inflammatory or congestive state of the bronchial or pulmonary vessels, which is very frequently the case, the treatment recommended for these conditions may be advantageously combined with some of the antispasmodics just mentioned: and when the nervous affection does not form the chief part of the complaint, it is probably dependent only on the altered condition of the membrane, which is either inflamed or congested; and to this condition therefore the remedial agents must be chiefly addressed. Under such circumstances depletions and other antiphlogistic measures which are rarely useful in purely spasmodic asthma become the best remedies.

2. The fulfilment of the second indication, to diminish excessive irritability of the bronchial muscles, and to remove the causes of irritation by which they are excited, will be best aimed at by various means which tend to restore a proper balance of the functions of the whole system, and to improve the general health. Of these the most effectual are those of diet and regimen. Particular rules can scarcely be laid down, and the experience of the patient is required to give a clew to the most eligible plan; but generally, a simple, light but nourishing diet, with great regularity as to hours, and moderation as to the quantity of food, will be the most suitable. The daily use of cold sponging to the chest, or the shower-bath if it can be borne, and of moderate exercise in the open air, avoiding walking against a strong wind, is generally beneficial. Of medicinal agents, besides those necessary to regulate the secretions, which always need attention, the metallic tonics sometimes prove useful in diminishing the morbid irritability of the bronchial muscles, or of the nerves that influence them. We have found in various instances the oxide and sulphate of zinc, the sub-nitrate of bismuth, the nitrate of silver, the milder preparations of iron, severally beneficial in diminishing the tendency to the recurrence of the paroxysms. Probably these remedies act through the nerves of the stomach, which are supplied by the same trunk (the *par vagum*,) with those which influence the bronchial fibres; and they may do this directly, or indirectly, by improving the condition and function of the stomach, disorders of which in some form or other are commonly associated with spasmodic asthma.

The signs of improvement are (besides the less frequent occurrence and diminishing severity and duration of the paroxysms) a more free state of the respiration in the intervals, so that the vesicular murmur is pretty audible without much wheezing, throughout the chest, and is increased, in loudness by quicker and deeper inspirations, not stopped or impaired as during the continuance of the asthmatic tendency, when additional effort will often at any time excite the spasm. In the cure of this, as of other spasmodic disorders, it is very necessary to study the circumstances that excite the paroxysms in each case, in order to be able to avoid them; for the frequent occurrence of spasm increases the facility of its return, until it becomes habitual and may be excited under almost any circumstances. The evil of an habitual asthma is not only the inconvenience and distress occasioned by the paroxysm itself, but also the permanent changes which it may induce in the structures of the lung, such as contraction and rigidity of the air-tubes, congestions, emphysema, and other lesions of the parenchyma, and diseases of the heart and whole circulating system.

Atonic or Paralytic Dyspnœa. Hitherto we have considered only the *spasmodic* form of asthma, or that dependent on an excessive contractility of the bronchial tubes: but as in examining the elements of dyspnœa we found that *defect* of these properties would disorder the process of breathing, we are led to inquire whether there may not be a nervous asthma or dyspnœa of this kind from weakness or paralysis of the circular fibres, or of the nerves which regulate their contractions. We have parallel affections of the alimentary and urinary passages,

when from local or general causes their moving fibres become torpid or paralyzed; and if we are right in supposing that the action of the circular fibres, as well as the elasticity of the longitudinal fibres of the bronchi, be essential to the effectual performance of the act of expiration, defects of the properties of these tissues must cause a proportionate imperfection in this act. We meet with instances of dyspnoea generally accompanying chronic bronchitic affections, but sometimes in hysterical females and other nervous subjects, in which this difficulty of expiration is the prominent feature; this part of respiration being wheezing, prolonged and attended with effort, whilst inspiration is comparatively short and easy. So, also, we see the defective action of the contractile fibres of the intestinal tube arise sometimes from previous over-irritation, and sometimes from more directly weakening or paralyzing causes, and sometimes from that irregular distribution of nervous influence which produces the phenomena commonly called hysterical. Nay, if we consider that irritations first exalt, and afterwards injure, the contractile properties of hollow organs or tubes, and that these irritations or inflammations affect successively different parts of the same tubes, we can understand that spasmodic and relaxed asthma may co-exist in the same person, one part of the bronchial tubes being unduly contracted, and another unduly relaxed, from an irregular distribution of the property of irritability. This subject will be noticed again under **DILATED BRONCHI AND AIR-CELLS.**

Treatment. Depending as this affection usually does on previous inflammatory or congestive affections of the air-tubes, the remedies generally useful at the decline of those lesions are such as may be supposed to act in some measure by stimulating or giving tone to the bronchial fibres. Thus ammoniacum, benzoin, myrrh, the balsams of Copaiba and Peru, and the inhalation of tar and other stimulating vapours, besides their operation on the discerning function of the air-tubes, may probably have an influence of this kind on their moving fibres; and they may thus improve their powers in relation to the act of both expiration and expectoration, the difficulty of which often forms the most prominent feature of many protracted inflammatory and congestive disorders of the air-tubes.

HOOPING-COUGH.

Symptoms—division into three stages.—Varieties and complications—Causes.—Anatomical characters.—Nature.—Diagnosis.—Prognosis.—Treatment.

THE disease known by the names *hooping-cough*, *pertussis*, *chin-cough*, *convulsive cough of children*, and which generally occurs once only during life, seems to combine several of the characters of inflammatory affections of the air-tubes with those of a nervous description, already adverted to, and, from its occasional severity and frequent complication with other serious diseases, merits careful consideration.

Symptoms. The simple or uncomplicated form of hooping-cough generally exhibits *three* stages: in the *first* it is inflammatory, a bronchitis or catarrhal inflammation; in the *second* it is both an inflammatory or at least congestive and nervous affection; in the *third* it is entirely nervous, although it may in some cases be complicated with alterations in the pulmonary structure. The *first* stage commonly begins as an ordinary cold, often accompanied with coryza, but there is more headach, languor, and often more febrile disturbance than usual; these symptoms sometimes precede the cough, which however begins earlier than in an ordinary cold. The general symptoms vary greatly in degree: being in some cases very severe, in others very slight, and not sufficient to require treatment.

In the former case the pectoral symptoms are also very severe at first, with pain, soreness and oppression of the chest, dyspnoea, and other symptoms of severe bronchitis. The cough is at first hard, short, and ringing, being apparently excited by the irritation of a thin saline-tasted mucus in the glottis. The transition to the *second stage*, which commonly takes place in from four to eight days, is marked by the cough coming on more in fits and of a more violent character. The tickling in the throat is less constant, but when it comes it cannot be borne an instant, but excites an uncontrollable cough, consisting of many repeated violent expiratory efforts followed by a long inspiration, which, by the hooping or crowing noise often accompanying it, may be known to be drawn through an imperfectly opened glottis.

The hooping depends on an undue irritability of the laryngeal and bronchial muscles, so that they do not relax, as usual, during the act of taking breath. But this sonorous back draught is not always heard in this complaint, particularly if the subject be not very young; and on the other hand it often accompanies other severe kinds of cough in children, in whom the aperture of the glottis is small and disposed to contract. This is farther illustrated by the result of auscultation. On applying the ear to the chest of a child during a fit of hooping-cough, one is surprised to hear so little sound of respiration within the chest with all the violent external motions; and during the sonorous back draught, there is scarcely any sound of air entering the pulmonary tissue. This is to be ascribed to the continued contraction of the glottis and large bronchial tubes preventing the air from penetrating to the vesicular texture with sufficient force to produce the ordinary respiratory murmur; for in the convulsive cough of adults there is no obstructed hooping inspiration, but a full forcible one which is heard loudly in all parts of the chest. The other physical signs of pertussis do not differ from those of mild bronchitis; there being often variable sonorous, sibilant, and mucous rhonchi in the upper and middle parts of the chest. The fits of coughing generally terminate in the discharge of a thin glairy mucous; and such is the violence of the action of the abdominal muscles that the contents of the stomach are often forced up by it. The termination of the cough in vomiting is merely the result of the violence of the action which produces the cough: as soon as the muscular efforts have compressed the chest as far as it will yield, their force falls on the stomach, and in proportion as the cardiac orifice yields is the completeness of the act of vomiting. This disposition is increased by habit; and consequently as the disease advances the fits of cough often terminate more frequently and speedily by vomiting or retching. The violent and convulsive character of the cough is its most characteristic feature; the face and neck become red or purple, and turgid; the eyes are injected; the throat, chest, and abdomen are quite sore with straining, and the whole frame is so shaken, that the child is obliged to lay hold of something to afford support, and seems to be on the verge of suffocation. It is no wonder, that with such straining the expectoration should be sometimes streaked with blood, or that blood should flow from the nose; yet this does not happen very often, but chiefly in the plethoric, or in those predisposed to epistaxis, and, if not excessive, is salutary. No wonder, too, that convulsions, coma, and other cerebral affections, are sometimes induced in young and delicate subjects. At this time the violent paroxysms of cough sometimes cause mechanical injury of the apparatus of respiration and circulation: the air-tubes and cells become partially dilated or ruptured, the passage of the blood through the lungs is impeded, congestions are produced, the action of the heart is disordered, the foramen ovale may sometimes be reopened, giving rise to blue discolouration and œdema of the surface, etc. At this period in severe cases also there is often remittent fever at night; and with it there may be combined the various inflammatory complications in the chest, head, and abdomen, which constitute the chief source of danger in these cases in pertussis. We shall advert to these hereafter. In slight cases there may be no fever, and little functional disturbance in the intervals of the cough; but the common presence of the sonorous and mucous rhoncus, particularly before and after

the cough, and the mucous expectoration in which the cough generally terminates, indicate that in all cases it is still a bronchitic or catarrhal as well as a nervous affection: and in fact, as this stage declines, the expectoration generally assumes the more consistent and opaque form which characterizes the concocted sputa of a terminating bronchitis.

This change, which may occur from the third to the sixth week after the commencement of the disease, marks its transition to the *third* or purely nervous stage. There is great variety in its severity in different subjects: in some the convulsive cough may only come on twice or thrice in the twenty-four hours, and cease in the course of a few days: in others it rapidly loses its convulsive character and subsides like a common cough; in the majority of instances, however, it retains its convulsive character to the last, but becomes less frequent in its attacks, and ceases from six to ten weeks from the commencement of the disease. Delicate nervous children often suffer long and severely in this last stage, which assumes somewhat the form of a chronic convulsive disease; and even after it has itself ceased, for a long time it gives its character to any fresh cough that may be contracted from other causes.

Varieties and complications. The first or febrile stage of the disease is complicated occasionally with extensive bronchitis, and more rarely with pneumonia, pleurisy, or croup. These complications generally occur at times of the year, and in situations, in which such affections prevail; or they, as well as other complications, may be the result of individual predisposition developed by the fever which accompanies the disease. The greater intensity of the inflammatory and febrile symptoms, the more continued oppression and pain in the chest or throat, permanent frequency of the breathing and pulse, with the physical signs distinctive of these several affections, mark their occurrence. The cough becomes less violent and sonorous, but still frequent, and in the intervals the mucous or crepitant rhonchus is heard in the chest, or there may be partial absence of the respiratory murmur, with dulness on percussion. Less commonly the membranes of the brain are affected, and the grinding of the teeth, the rolling of the head, intolerance of light, contracted pupil, followed by squinting, vomiting, screaming, &c., indicate the presence of acute hydrocephalus.

With any of these complications unsubdued by treatment the disease may prove fatal in the course of a few days with the usual symptoms of these affections. In the second stage the most frequent complications are partial pneumonia, hydrocephalus, and gastro-intestinal inflammation. Circumscribed or lobular peripneumony is a very common and fatal complication of severe hooping-cough among the children of the poor. It causes continued dyspnoea with quick pulse and hot skin, and crepitation or obstructed respiration and dulness in some part of the chest. Effusion in the brain may be apprehended when convulsions come on, or when between the fits of coughing the child rolls his head from side to side, with moans indicative of pain, or when he lies in a lethargic or half comatose state, with dilated or contracted pupil, strabismus, and paralysis or contraction of some of the limbs. This formidable complication is by no means uncommon in young children during the period of dentition. Gastric mucous inflammation is marked by the characteristic appearance of the tongue, continual thirst, occasional vomiting not excited by the cough, pain or tenderness at the epigastrium, looseness of the bowels, the stools being offensive, dark or clay-coloured: or in some cases constipation, scanty high-coloured urine, with burning heat coming on at night, followed by perspiration, progressive emaciation, &c. These signs of gastric irritation are sometimes combined or followed by those of inflammation and effusion in the head; or if this organ escape, and the abdominal irritation proceed, accompanied by the cough, it may terminate in tuberculous disease of the lungs or of the mesenteric glands. In these complicated cases, if the patient survive the dangerous lesions until the usual period of the third or nervous stage, the phenomena of this stage vary much according to the nature of the complication, the convulsive cough being sometimes absent and sometimes unusually severe in the cephalic cases; whilst those, in which the gastro-intestinal mem-

brane or the lungs take on permanent disease, in some instances retain the convulsive character, and in others they present merely that of chronic cough.

Causes. Hooping-cough may occur epidemically, sporadically, or it may be propagated by infection. The latter cause is questioned by some writers, but there is as much evidence in favour of the infectious properties of this as there is of any other disease, it having been known to spread among a family and neighbourhood from one case brought from a distant part; and its extension to other children being often prevented by their removal. It resembles the other contagious diseases of children in its rarely occurring more than once in the same individual. Like these, however, the disease spreads more rapidly under certain unknown epidemic influences; and passes by individuals in a manner that proves some bodily predisposition to be necessary for its production. Its epidemic prevalence has been frequently observed to accompany that of measles; the one disease sometimes succeeding to the other.

The period of life in which it most commonly occurs is between the ages of two months and twelve or fourteen years, but it occasionally happens before and after, and a few individuals escape it entirely. On the other hand, when it has occurred during infancy, it occasionally though very rarely recurs in after life. This happened to the writer, who suffered severely from a second attack in Paris in 1826, having probably contracted it during his attendance at the Hôpital des Enfants Malades. Mothers have also been known to have the disease a second time when suckling a child labouring under it. We have seen many instances in which adults, who in early life had pertussis, contract a cough of a convulsive character during the prevalence of the disease among children in the house. It has been occasionally observed when hooping-cough attacks adults, the paroxysms recur during the night only, interrupting sleep and exhausting the strength. In children also the paroxysms are often more frequent and violent during the night. The infectious properties of the complaint probably last during its first two stages, but this is very uncertain.

Anatomical characters. As hooping-cough rarely proves fatal, except in consequence of its complication with some other disease, it is not easy to learn from anatomy its essential effects. Most writers agree, however, that the lining membrane of the windpipe, from the epiglottis to its larger branches, is more or less injected and often covered by a thick mucus, and the bronchial glands are also red and much enlarged. Dr. Copland adds his testimony to that of Ozanam of Milan that the œsophagus also bears marks of inflammation; and he mentions having observed inflammatory appearances in the medulla oblongata and its membranes, even when there was no other remarkable lesion within the cranium, but he does not state what these appearances were. In the complicated cases, the common effects of inflammation are found in the organs which have been peculiarly affected. Thus in the bronchitic cases the bronchial membrane is much more extensively inflamed than usual, and the tubes are every where filled with spurious mucus, sometimes mixed with pus. The results of pneumonia are seen in the engorgement and hepatisation of portions of the lungs, in these cases often confined to lobules, particularly about their margin. In more protracted cases tuberculous deposits are sometimes formed, and the air cells and tubes are often irregularly dilated. Various products of inflammation are, in some instances, met with in the pleura and pericardium. When the head has been affected, serous effusion and opacity of the membranes have been seen in the brain, and rarely softening of its substance. When there has been remittent fever the mucous membrane of the ileum, cæcum, and colon is found inflamed, and occasionally ulcerated, and the mesenteric glands enlarged; in prolonged cases with a scrofulous tendency, tuberculous matter is deposited in these glands.

In cases of hooping-cough which terminate quickly in death, there is no prominent lesion; the brain is a little more livid than usual, both in its cortical and medullary portion, but there is no effusion of serum, and its consistence is not materially affected. The bronchial tubes

contain a thick mucus, and are rather bluish than reddened. If the disease continue for a long time, the bronchi are dilated and filled with the same viscid secretion: the dilatation evidently arises from the repeated attacks of cough, and tends to retard the recovery of the patient. The complications which may occur in the course of the disease are very numerous; they are inflammation of the lungs and brain and tuberculous formations, especially the minute semi-transparent granulations and tubercles in the bronchial glands; they are of course extremely variable.

G.

Pathology. There has been a great diversity of opinion respecting the nature and essential seat of pertussis. Cullen, Guibert, Hoffmann, Hufeland, and most other German authors, consider the disease as essentially nervous, depending on irritation (not inflammation) of various parts of the nervous system, particularly the phrenic and pneumogastric nerves, and causing spasmodic action of the larynx, diaphragm, and stomach. Leroi, Webster, and Begin ascribe the disease to inflammatory irritation of the brain and its membranes. Watt, Badham, Dawson, De-wees, Guersent, Laennec, and most other French authors hold the disease to be essentially bronchitic or catarrhal, with the addition of convulsive action of the diaphragm and larynx, excited, according to some, by an excessive sensibility of the inflamed bronchial membrane. A third view, particularly maintained by Desruelles, is that hooping-cough depends on inflammation of the bronchi speedily causing irritation in the brain, whence is reflected convulsive excitement of the diaphragm, muscles of the larynx, &c., which gives to the cough its peculiar character. Dr. Copland considers the disease to be essentially a nervous irritation, commencing in the respiratory surfaces, and through the nerves, chiefly the pneumogastric, transferred to the medulla oblongata, whence it again affects the respiratory apparatus and sometimes the stomach; and that predisposing or concurrent causes may readily convert this irritation, at either of its seats, into inflammation.

In reference to these different views we may remark that in many instances they do not sufficiently regard the physiological character of those morbid motions which form the chief feature of hooping-cough. Thus we find much ascribed to the phrenic nerve and diaphragm, when it is obvious that these agents of inspiration are little, if at all, concerned in the motions which constitute the cough. We regard hooping-cough as originating in a specific irritation (almost always inflammatory at first) of the lining membrane of the upper portions of the air-passages. This irritation is in the first stage constant, and accompanied with cough and expectoration, like those of common inflammatory catarrh; but in the second stage it peculiarly increases the irritability of the laryngeal constrictor and bronchial muscles, and of the nerves which excite the contractions of these as well as of the expiratory muscles which are sympathetically associated with them—those in fact which are concerned in the act of coughing. The peculiar cough of pertussis resembles that excited by a foreign body directly irritating the glottis; in fact it is properly called *pertussis*, for it consists of an exaggeration of all the actions of an ordinary cough and of nothing more; and there is no more reason for seeking its cause in the brain or spinal marrow, than there is for referring excessive vomiting or dysenteric straining to this seat. It is unnecessary to go farther than the respiratory apparatus for an explanation of the phenomena of hooping-cough. The irritation which at first extends to the vessels and is more constant, becomes afterwards purely nervous, and like other local nervous affections, such as neuralgia, spasms, nervous colic, &c., manifests its effects only occasionally, perhaps under the influence of some additional exciting cause. The various complications which so much increase the danger of hooping-cough, we would regard chiefly as the effects of the violent cough, sometimes assisted by predispositions to particular diseases or by co-operating causes. Any one who has witnessed the severe paroxysms of hooping-cough can scarcely wonder that it may produce in the head, in the lungs, and in the abdomen, serious congestions, which previous tendencies,

or additional exciting causes, may readily convert into inflammation and its effects—hydrocephalus, pneumonia and intestinal disease.

Diagnosis. The convulsive character of the cough, consisting of a rapid succession of violent short expirations, followed by a long inspiration, which is hooping in young children, forms the most distinctive feature of pertussis. Its termination in the discharge of glairy mucus, or of the contents of the stomach, also seldom happens habitually in other coughs. The convulsive or hysterical cough of adults sometimes exactly resembles pertussis even in the hoop; but the history of the case, and the alternation of the affection with other nervous complaints, will serve to distinguish it.

Prognosis. Hooping-cough, when occurring in children previously healthy, and not disposed to visceral disease, and when unattended with high fever at its commencement or with great violence and frequency of the paroxysms afterwards, is not a dangerous disease. But it is highly dangerous and destructive when, either from the delicacy or previous tendency of the subject, or from the violence of the cough, it becomes complicated with inflammatory or congestive lesions of the head, chest, or abdomen. When, therefore, it attacks young children, under two years old, who are under the additional influence of the irritation of early dentition; or when it attacks children who are delicate from constitution or prior disease, or who belong to a family in which hydrocephalus or scrofula has prevailed; or when it comes on in any subject with high fever, difficult breathing, and other signs of complications: or when from the extreme violence and frequency of the cough these may be expected to ensue,—the prognosis must be expressed in terms of uncertainty.

Treatment. The three stages which the disease presents, form the ground of indications of treatment, varying as the complaint advances; and the complications, when present, will also furnish farther indications. In the first stage moderate antiphlogistic measures; in the second, these in combination with expectorants and sedatives to allay the nervous and muscular irritability; and in the third stage, antispasmodics and nervous tonics,—form the chief indications of treatment of simple hooping-cough. In the milder cases, very trifling measures, such as an occasional emetic and mild aperients, and avoiding imprudent exposure, when the weather is variable, may suffice; and, except in the early stages, confinement is unnecessary: in the severer forms, however, close attention to the symptoms will be required throughout the complaint.

The first stage is to be treated much in the same way as ordinary catarrhal bronchitis, which it resembles. Blood-letting only in the plethoric or when inflammation runs high, antimonial expectorants, and occasional mild mercurial and other aperients, are the chief remedies. If there be much heat of skin, a few doses of James's powder, or of an antimonial saline with nitre, should be given.

In the second stage, the antimonial expectorant may be continued with advantage; but it must now be combined with a sedative, to diminish the violence of the paroxysms of cough. These paroxysms generally terminate with the expectoration of glairy mucus; and by favouring this secretion, antimonial or ipecacuanha wine in small doses, combined with an alkali, as in bronchitis, will generally shorten the duration of the fit. Full emetic doses have been very strongly recommended with the same view; but, except in case of accumulated bronchial secretion, we consider that equal benefit may be derived from expectorant or slightly nauseating doses, for they are far less weakening, and are quite sufficient to induce vomiting if that be desirable. Of sedatives, those most recommended are hydrocyanic acid, belladonna, and opium. The first has been highly extolled by Drs. Granville, Elliotson, and Roe; but its administration demands great caution, especially in young children, for its sedative influence affects the heart as well as the muscles and nerves of respiration; and the circulation of very young subjects, if suddenly depressed, does not readily recover its power. Belladonna has been much recommended by several continental practitioners. We have found it more safe and

more effectual than prussic acid; and its dose may be considerably increased without any real risk. We have given a quarter of a grain three times a-day to a child of two years old, half a grain to one of four, and a whole grain to one of eight years of age; and increased these quantities to double and more when they ceased to relieve. These doses generally cause dilatation of the pupil; and we conceive that the remedial agency of the drug depends on the same power to diminish the irritability in the laryngeal and bronchial nerves and muscles, which is thus evinced with regard to the iris. In a few cases there have been some feelings of heat and dryness in the throat, giddiness, and pain over the eyes; but these symptoms soon cease when the medicine is discontinued. They are more alarming than dangerous, for instances have occurred of upwards of a drachm of the extract being taken without any bad effects farther than the continuance of these symptoms for a day or two. Belladonna often signally diminishes the violence and frequency of the paroxysms of cough; but as it is liable to lose its efficacy by constant use, it is better to intermit it for a few days, and then resume it. In the more violent cases, it is necessary to resort to the stronger sedative—opium. It is best given in form of solution of one of the salts of morphia, combined with ipecacuanha and small occasional doses of calomel or hydr. cum cretâ. Its administration requires much caution in very young children and those with cephalic symptoms: in these it should be always combined with calomel. Sirup of poppies is objectionable on account of the uncertainty of its strength.

At the early part of the second stage, blisters are often beneficial, especially if there be more than usual bronchial inflammation: with young children they should not be left on for more than three hours. Afterwards stimulant and anodyne liniments rubbed over the whole chest occasionally prove useful. Camphorated liniment, with additions of oil of turpentine or amber and ammonia, may be applied. Tartar-emetic ointment has also been recommended for the same purpose; but it is less eligible, for the painful pustules which it excites prevent the continuance of the daily friction to which embrocations seem to owe much of their efficacy.

In the third stage, when the complaint is purely nervous, besides the sedatives and antispasmodic embrocations, another class of remedies becomes of great utility—tonics and even stimulants. Bark, myrrh, preparations of iron, arsenic, sulphate and oxide of zinc, nitrate of silver, assafœtida, musk, tincture of cantharides, and many other medicines of this class, have been much extolled by different writers; and each, perhaps, is occasionally useful in particular cases. In the choice of them, the practitioner must be guided by general principles or analogies. Thus, in cases presenting a periodic character attended by debility, bark or arsenic may be most suitable: in those of a more convulsive type, assafœtida, musk, or tincture of cantharides, followed by the preparations of zinc or silver, may be found useful; whilst in cases decidedly asthenic, steel medicines are far more effectual. Of the latter, the ammoniated iron and carbonate of iron are generally the best preparations. M. Lombard, of Geneva, has recently written strongly in favour of the carbonate of iron, which he uses to the extent of twenty-four to thirty grains in the day even for very young children. In the employment of this and other tonic remedies, it is important to keep the excretions free; and to withhold the tonic, if there be any signs of obstruction, inflammation, or vascular irritation.

Diet and regimen. In the early stage the diet must be light, consisting of milk and farinaceous food. In the second stage white meat or jelly may be allowed; and children who are pallid may sometimes with advantage be permitted to take meat and the more nourishing articles. In the third stage the diet may be as in health. In the first or inflammatory stage of hooping-cough the child should be confined to the house and warmly clothed; and exposure of every kind should be avoided as much as in bronchitis. But towards the end of the second stage, when all feverishness and sharpness of the pulse have subsided, much benefit may be derived from the open air, and especially from a change of

air. In the last stage, a change of air is almost a specific; any kind of change, and although only to the distance of a few miles, will sometimes entirely remove a cough that has baffled all medicines.

Treatment of the complications. When in the early stages of the disease, connected with its febrile onset, there are signs of inflammation in the head or chest, the appropriate antiphlogistic treatment must be employed, but not with the same freedom as if this inflammation were the only lesion. No antiphlogistic treatment will stop the course of whooping-cough; and a certain amount of strength must be reserved to support the patient through it. With this qualification we may refer to ACUTE HYDROCEPHALUS and PNEUMONIA for the treatment proper in these complications. The congestive inflammatory complications arising in the second stage from the violence of the cough and other concurrent causes, may be more successfully guarded against than cured. A few leeches to the head or chest, when any signs of congestion or irritation show themselves there, the occasional exhibition of mercurial aperients, the removal of dental irritation by free scarification of the gums, and the continued use of measures calculated to diminish the violence and bad effects of the cough, constitute the chief means of preventing the production of serious disease. Of these, none is more important than the precaution of raising the child to a proper posture when attacked by the cough. It is a case in which a careful nurse is invaluable. The child should never be allowed to lie, or to hang its head down, during the severe fits. The paroxysms when very severe, and causing great turgescence and lividity of the face, may often be cut short by dashing cold water on the face, or by blowing into the ear. When once hydrocephalus or pneumonia has been induced, it must be treated, as far as the strength will bear, in the usual way; but from the weakness resulting from the previous disease, and from the repetition of the cough which it yet induces, these secondary forms of lesions are more fatal than when they occur idiopathically. Remittent fever, or other symptoms of gastric irritation, must be treated on the usual plan of mild alterative aperients, a strictly regulated diet, occasional warm baths, &c. In case of chronic bronchitis, pneumonia, or pleurisy, which in some instances succeed to whooping-cough, the treatment recommended for these affections must be adopted.

The convulsive cough of adults, not of a specific nature, is generally associated or alternated with other forms of spasmodic or convulsive disease, in which there is a great mobility of various muscles, an exaltation of the natural relation which subsists between certain nerves and the muscles which they influence. In several such cases, we have found extract of belladonna with the pilula aloës and assa-fœtida, and a galbanum or pitch plaster to the chest or back, give most effectual relief. Where the complaint is more obstinate, a course of the metallic salts, sub-nitrate of bismuth, nitrate of silver, sulphate of zinc or ammoniacet of copper, is often successful in removing it. They may generally be much aided by the shower-bath, country air, exercise, and other means which diminish the mobility of the nervous system.

NEURALGIA, OR PAINFUL SENSIBILITY, OF THE AIR-TUBES.

A pain in the larynx or under the sternum is sometimes produced independently of inflammation or any other affection. It is most commonly excited by breathing cold air, but sometimes comes on independently of any such cause. This morbid sensibility, although often, is not invariably accompanied by increased contractility. Spasmodic asthma, or spasm of the glottis, may be unattended with any other pain than that common to dyspnoea; and on the other hand, the weak or relaxed state of the bronchial tubes, marked by difficult or imperfect expiration, is sometimes accompanied by an increased sensibility of the bronchial membrane, so that the breathing of cold or irritating air becomes unusually painful. Under such circumstances the pain may be considered as nervous, depend-

ing on an excessive sensibility of the sentient filaments of the par vagum, like the gastrodynia and morbid sensibility of its gastric branch.

Treatment. The direct application of narcotics, by inhaling their vapour or smoke, will sometimes relieve nervous pain of the air-tubes. The vapour of hot water charged with camphor or conium with an alkali, smoking a cigar, or even holding in the mouth a lump of camphor or a warm aromatic lozenge, a bit of ginger, or a clove, will in some cases remove the pain, and enable the individual to take breath freely. Where cold air only excites the pain, a respirator, or some warm porous material held to the mouth, will prevent it. But it is better to attempt to reduce the morbid sensibility by the daily use of the shower-bath, or by freely sponging the throat and chest with vinegar or salt water, at first tepid, but after a few days quite cold.

STRUCTURAL LESIONS OF THE AIR-TUBES.

Hypertrophy and induration.—Dilatation, Contraction and Obliteration.—Ulceration.—
Tumours.

HYPERTROPHY AND INDURATION OF THE AIR-TUBES.

CHANGES of structure in the bronchial tubes are most commonly the result of inflammation, or of some kindred modification of the nutritive process. Frequent recurrence or long continuance of inflammation of the bronchial membranes, as in other structures, changes their condition, and the mechanical forces to which they are subjected in the function of respiration may variously modify this change. The most simple change of structure is a mere thickening of the mucous and sub-mucous tissues. This generally in some degree accompanies acute inflammations, but is then only temporary, and subsides as the secretion becomes free and albuminous; being caused, probably, by only an infiltration of the pores of the tissue with soft lymph, which, as the inflammation subsides, is eliminated and expectorated with the mucus of the membrane. The deposits that are the most readily produced by inflammation in highly vital tissues, are also the most readily removed; and thus it is that the soft albuminous matter that is effused by acute inflammation in cellular textures and in parenchymatous organs in general, if it be not so abundant as to compress the vessels, becomes absorbed as the inflammation subsides.

But it is otherwise when the inflammation recurs frequently, or lasts long; for it then causes an effusion less susceptible of absorption, involves the less vital structures; and as the changes induced are slow, so they are more permanent, because they become identified with the nutritive or reparative functions of these tissues. A degree of hypertrophy is then produced of some or all of the various tissues composing the tubes. Sometimes there is extraordinary thickening of the mucous membrane, so that it forms projections within the tube. More commonly, however, it is the harder and less vital textures that undergo the change, and its effects is to increase the rigidity of the tubes, so that there is a diminution of their expansibility and contractility. Nothing is more common than to find the air-tubes of persons who have long suffered from bronchitis, presenting an unusual development of the longitudinal elastic fibres. In other cases, the outer cellular coat of the larger bronchi is thickened and indurated, and their cartilages are sometimes partially ossified. Any of these changes has the effect of rendering the lungs less easily expansible in respiration: the first in particular is a common cause of the short breath from which persons frequently affected with bronchitis ge-

nerally suffer; and although not often serious in itself, yet it may so abridge the sphere of the function of respiration as to make its increased exertion, during bodily exercise, a matter of difficulty and disorder, and to render it ill able to bear any other disease, to which the lungs can in general adapt themselves by supplementary efforts.

The chief sign of hypertrophy of the longitudinal fibres, and of increased rigidity of the tubes generally, is difficulty of inspiration, which is short, quick, and performed with an effort, especially on making any exertion; whilst the expiration is comparatively easy: but both acts are often accompanied by wheezing sounds from irregularities in the caliber of some of the tubes, and frequently from partial congestion or inflammation, from which tubes thus diseased are rarely free. The vesicular murmur is impaired, and the expansion of the whole chest is perceptibly limited. These signs resemble those of spasmodic asthma, except that they are permanent, and are not removed as the latter may be, for an instant, on breathing after holding the breath in the manner before described.

Inasmuch as these lesions seem to arise from continued inflammation, it becomes of the more importance to direct remedies against those forms of bronchitis that are habitual or frequently recurring. An imperfectly cured cough will often harass a patient for months, and even for years. In process of time the breathing becomes permanently shortened, and an irritation is often fixed in some of the tubes, manifesting its effect on their secreting function by habitual expectoration, generally thin and mucous, sometimes muco-purulent. This affection varies greatly in degree. We have known several cases of habitual dyspnœa, presenting the characters now described, ultimately prove fatal, and after death no other lesion discovered than a general redness of the membrane lining the larger tubes, and an extraordinary development of the longitudinal fibres. There is one point with regard to treatment particularly suggested by a knowledge of this change of structure, that not only should the practitioner persevere in the use of the means which tend to eradicate the low degrees of inflammation that produce it, especially alkaline expectorants and counter-irritants, but he should also endeavour to countervail, by *mechanical* means, that mechanical limitation which this change induces in the size of the tubes. If the patient use no exertion and give his lungs little play, any increase in the rigidity of the tubes will more readily fix them in their present contracted state; but if he take moderate exercise, increased as habit improves his power, the lungs will be kept in that free mobile condition that is least favourable to rigidity or deposition of any kind. Probably special efforts of inhalation would be useful with the same view; and as this might be combined with some mildly stimulating vapour, such as that of water impregnated with tar or camphor, it might be also serviceable in improving the secreting properties of the membrane. It is obvious, however, that great discretion is necessary in the employment of these mechanical means, for if they strain the tubes beyond the due limits, they may cause a morbid yielding of the walls, and increased inflammation; and if exertion be used beyond what the function of circulation can readily support, it will occasion congestion in the lungs, which may aggravate the original disease, and induce lesions of other kinds. These mechanical measures are more adapted for young than for old subjects; because in the latter the change is more likely to be permanent, under the influence of that general law by which, as age advances, fibrous tissues tend to assume a cartilaginous hardness, and cartilage becomes rigid with osseous matter.

DILATATION, CONTRACTION, AND OBLITERATION OF THE AIR-TUBES.

On examining the lungs of patients who have long suffered from complaints of the chest, it is not uncommon to find the bronchial tubes, when laid open by a pair of scissors from the large to the smaller branches, exhibit dilatations of different kinds, the enlargement being usually most apparent in those parts of the

tubes where the cartilaginous plates are small and few; but occasionally the larger tubes are also dilated, their rings only here and there limiting their dilatation. Sometimes the dilatations are pretty uniform through some length of a tube; in other cases they form irregular roundish cells or pouches, freely communicating with each other, from which other tubes arise either dilated or undilated. The tissues surrounding the tubes are generally more or less altered. They are least so in the uniform or tubular form of dilatation, in which the coats are often quite thin, and the longitudinal fibres distinct, although occasionally enlarged. But in the more globular or cellular dilatations, the walls of the tubes are commonly much altered; they are irregularly thickened, the thickening being formed in part by hypertrophy of the mucous and sub-mucous tissues lining the tubes, and partly by a dense tissue on their outsides, probably consisting of the parenchyma of the lung compressed by the encroaching tube. There is little or no trace of the longitudinal or circular fibres in this form of dilatation, and the lining membrane is generally in a softened state, and of a red colour, whilst some parts of the tubes are quite rigid. We shall better understand the pathology and signs of these lesions by examining a little into their causes.

Laennec, who first described dilatation of the bronchi, ascribed it to the frequent accumulation of mucus in the tubes, causing their mechanical distention. He considered that they were formed especially by long-continued chronic bronchitis, and that the continual recurrence of the same distention of the tubes led to their permanent dilatation. But this view is by no means sufficient to account for the remarkable changes which we frequently see in the structure of the dilated tubes; nor do these lesions constantly occur where the bronchial secretion is copious, and most calculated to cause distention. M. Andral takes a more rational view in ascribing these lesions to a modification in the nutrition of the textures composing the tubes; but he does not attempt to explain the mode in which the change is effected. If, however, we bear in mind the details of the internal mechanism of respiration, and the manner in which they may be deranged by disease in the various textures concerned in them, we shall find no difficulty in tracing several causes of dilatation of the air-tubes, as well as an explanation of the changes in their tissues and those of the surrounding parts. A mutual pressure is continually exerted between the interior of the bronchial tree and the air: in inspiration, by the air which enters to distend the tubes; in expiration, by the tubes contracting to expel the air. In forcible acts of respiration, such as coughing or energetic breathing, this pressure is increased; but in the normal condition of the tubes when they all equally and freely convey the air to and fro, and meet the pressure with a well-proportioned degree of elasticity and contractility, this pressure is balanced and borne well. But if in any way the equality of this pressure be disturbed, or those elastic and contractile properties that are opposed to it be deranged, it becomes converted into a cause of unnatural distention in some parts, while it does not reach others with sufficient force. There are several conditions which may cause these disturbances, and they are especially to be met with in those diseases which are known to lead to dilatation of the air-tubes. Bronchitis may act in both these ways: by thickening of the membranes or by viscid secretions, it may cause partial or complete obstructions, which by preventing the free entry of air into some tubes, increase its pressure into others, which become distended in consequence; and it may alter the condition of the tissues composing the tubes, so that, losing their elastic and contractile properties they yield to the pressure and become fixed in this dilated condition. Perhaps, as Dr. W. Stokes has suggested, the mere loss of contractility may in itself be sufficient to cause dilatation of the bronchi; but our view will be more satisfactory if we take into consideration that this distending force is applied to textures softened and otherwise modified by inflammation, and that the change may thus become perpetuated and combined with other alterations in the textures affected. Hence the lesions are often not simple dilatations of the tubes, but comprehend also irregular softenings and indurations, atrophy and thickening of their several textures:

so that when the lung is cut open after death, it may be at first difficult to discover that the irregular cavities and indurations which it presents are formed by dilated tubes. Then in the production of these dilatations we are not to forget the influence of violent acts of respiration. They have been observed to succeed to whooping-cough, and other bronchial affections in which the cough is particularly violent and long-continued. But we have met with cases of dilated bronchi in which there had been very little cough, and none of any violence; and here we must suppose that the other causes, the irregular introduction of air, and the partial yielding of the tissues, were more exclusively concerned in the production of this lesion. Of this kind are the following cases. In pleuro-pneumonia, the lung is inflamed and at the same time compressed by an effusion in the sac of the pleura: if it remain long in this state, the smaller air-tubes and cells become obliterated by the adhesion of their sides, so that when the liquid is removed from the pleura, they will not expand again with the enlargement of the chest; but the large and middle-sized bronchi are not obliterated,—they bear the whole force of the inspired air, and become consequently dilated by it. These cases, although not uncommon, were not noticed by any writer, until described in the author's lectures published in the *Medical Gazette*. Dr. Corrigan has since described cases of dilated bronchi, which seem to be of the same character, although he refers them to the production in the lung of a new contractile tissue, like the cirrhosis of Laennec. We doubt the propriety of giving such a name to a lesion which seems to be the result rather of inflammation modified by the circumstances of compression or of slow progress, than of a peculiar production like the cirrhosis of the liver. Other lesions which cause the obliteration or obstruction of a considerable number of tubes and cells, tend to produce dilatation of the adjoining tubes, on which the motions of the chest act with augmented force. Thus it was observed by M. Reynaud, that when bronchial tubes become obliterated in consequence of the effusion and organization of lymph within them (a result connected with pneumonia rather than bronchitis,) they are sometimes dilated up to the obstruction, and the neighbouring tubes and cells commonly so. The same result is not unfrequently observed in connexion with tubercles which press on some tubes or obliterate the cells to which they lead. Larger tumours, such as aneurisms and cancer of the bronchial glands, pressing on one of the great bronchi, in a similar way cause unusual distention of those parts of the lung to which the other bronchus leads.

The symptoms produced by dilatations and contractions of the bronchi vary according to the extent of the lesions. Slight degrees of them are met with in the bodies of persons who had not during life manifested any prominent disorder of the respiration; and their simpler forms may exist to a greater extent without producing other effect than a liability to attacks of bronchitis. But where many tubes are affected, their structure modified, and much of the vesicular parenchyma obliterated in consequence, there are then produced habitual dyspnoea, with more or less cough and muco-purulent expectoration, which is often remarkable for its fœtor. The ordinary symptoms of severe chronic bronchitis, from which some of the affected tubes are scarcely ever free, are generally present; and the permanency of these symptoms, together with a degree of lividity, dropsical effusion in different parts, and cachectic condition of the whole frame induced by the crippled state of the lungs, constitutes the usual general character of the aggravated forms of dilated bronchi.

The physical signs of dilated bronchi are very intelligible. The air passing through them in respiration causes a louder, hollower, more blowing sound than in those of the natural dimensions; hence a kind of tracheal or cavernous respiration is heard over them in regions where naturally the respiration is vesicular; and if, as it frequently happens, there be liquid in the tubes, the bubbling into which it is thrown will be coarse and gurgling, instead of the finer mucous rhonchus of common bronchitis. So also the voice may be powerfully transmitted through these enlarged tubes, not as usual in a diffused fremitus, but loud and

startling, as if issuing from the spot; in some cases cracked and jarring as in bronchophony; in others more articulate, and with a snuffling or hollow sound, as in pectoriloquy. These however are also the signs of tubercles and excavations in consumption, with which the lesion under consideration is commonly confounded; we must therefore seek for other distinctions. Besides in the history of the case, and in the character of the constitution, these are sometimes to be found,—in the situation of the sounds, which in phthisis is usually in the upper parts, but in dilated bronchi in the middle regions of the chest; in their character in relation to time, those in phthisis tending to increase and spread as the excavations proceed, whilst those of dilated tubes will remain nearly stationary for weeks and months; in there being less change in the shape of the chest with dilated bronchi than with phthisis, unless they have succeeded to pleuro-pneumonia, in which case the change is different; and, finally, in the nature of the sound on percussion, which in phthisis is more dull chiefly under the clavicles, whereas, in dilated tubes, if any dulness exist, it is generally in the mammary, lateral, or scapular regions of the chest, and is often accompanied by a peculiar hollow sound, which, from its resemblance to that produced by mediate percussion on the trachea, or by tapping with the finger on the mouth of a phial, we have called *tracheal* or *amphoric*. We shall have occasion to mention this sign in treating of pleurisy and pneumonia. The differential diagnosis between dilated bronchi and phthisical cavities will be better understood when the signs and symptoms of the latter have been fully described. We shall only add here, that when a case presents itself in which there have been cough, long-continued with expectoration, dyspnoea, loss of flesh and strength, hectic fever, and even some of the physical signs of cavities in the lungs, the practitioner should be cautious in pronouncing it to be tubercular, if it be qualified by all or most of the following conditions:—If no proofs of a scrofulous habit can be traced; if the complaint have originated in a long-continued and violent cough, or in an attack of pleuro-pneumonia, and, considering its duration, emaciation have not proceeded far; if the purulent expectoration have been fetid and sanious, rather than flocculent or caseous; if the bronchial or cavernous respiration, or voice, be heard rather in the middle than in the upper portions of the chest, and be there spread over a considerable extent of surface; if these middle portions chiefly sound differently on percussion, being dull when the rest of that side sounds pretty well, or amphoric when the side is generally dull and contracted; and if, although the cough and expectoration continue undiminished, these signs remain stationary for many weeks together. In such a case the strong probability is in favour of its being one of dilated bronchi, and not phthisis.

It is obvious that dilatations of the bronchi, when once formed, can be little under the influence of medicine. The profuseness of the secretion may sometimes be restrained by acid mixtures; and we have known the nitro-muriatic acid in a few instances for a time remove its fætor. Probably inhalations of chlorine or iodine would be useful in such cases. Where the cough is violent and troublesome, it should be allayed as much as possible by sedatives, such as hyosciamus, belladonna, conium, and particularly opium or some of the preparations of morphia; due attention being at the same time paid to the state of the excreting functions and the general condition of the system, which may need various kinds of treatment in different cases. The coexistence of chronic bronchitis often renders external counter-irritation of service, and other antiphlogistic measures are occasionally required for supervening acute inflammation. It is, however, from preventive measures that we may expect more success; and our knowledge of the causes and tendencies of this lesion suggests the inexpediency of abandoning the treatment of cases of bronchitis, pertussis, and pleuro-pneumonia, until the cough and physical signs have been satisfactorily removed. Most of the severe cases of dilated bronchi that have fallen under our observation, we have traced to imperfect treatment in former inflammatory attacks, especially those

affecting the parenchyma of the lungs, which have yet been disguised under the name of a severe cold or influenza.

ULCERATIONS, TUMOURS, ETC., OF THE AIR-TUBES.

Ulcers seldom originate in the bronchi, but in connexion with some cause which concentrates inflammation in a peculiar manner on the bronchial membrane, and carries it to the sub-mucous tissues, such as the habitual inhalation of irritating particles of dust, in the occupations of needle-pointers, stone-masons, and leather-dressers, the continued passage of tuberculous matter in phthisis, and occasionally the specific influence of measles, scarlatina, small-pox, and syphilis. We can describe no signs by which the presence of ulcers in the bronchi can be distinguished: but they rarely, if ever, exist without similar lesions in the larynx, in which case the voice is often impaired or lost. Ulcerations of the trachea and larynx are very common in phthisis, and from the observation of Louis, seem to be in some degree caused by the contact of the matter expectorated, for he found them particularly on that side of the windpipe on which the lung was most excavated. Ulcers of the larynx are commonly the effect of chronic laryngitis, which has already been described.

Tumours of various kinds are occasionally developed in the windpipe, and others external to the tube may press upon it and interfere with its function. The most common seat of the former is in the larynx: if small, they may continue long accompanied with violent cough and fits of stridulous breathing from spasm like chronic laryngitis: if large or of rapid growth, they may speedily occasion suffocation, preceded by the symptoms common to irritation and obstruction of the larynx.

External tumours pressing on the air-tubes are not of a very uncommon occurrence. Of those situated in the neck, bronchocele sometimes has this effect; but, as Dr. Stokes has observed, it is chiefly by tumours originating within the chest, where the windpipe is surrounded by an unyielding frame of bone, that compression of this tube is produced. Such are aneurisms of the aorta and innominate, various tumours of the deep-seated cervical and bronchial glands, and enlargement of the thymous gland. We have met with instances of all these lesions, except the last, inducing pressure on the windpipe or one of its branches, and inducing dyspnoea, which in some cases was the obvious cause of death. In two cases the tumour was encephaloid, originating apparently in the bronchial glands, and surrounding the trachea at its bifurcation, both of the branches in one instance, and one in the other, being considerably compressed by it. In one of these cases the blood-vessels, although passing through the tumour, appeared to be quite free; in the other, the vena innominate was partially compressed. In a case of aneurism of the ascending aorta the right bronchus was compressed. In another of aneurism of the innominate the trachea was compressed at its bifurcation.

The signs of aneurisms compressing the air-tubes, have been particularly described by Dr. Stokes. The general symptoms are dyspnoea, generally accompanied by acute bronchial irritation and a sense of constriction under the sternum, occasionally dysphagia, distention of the jugular vein chiefly on one side; œdema of the face, and other signs of venous compressions. The chief physical signs are hissing or sonorous respiration heard best at the top or on one side of the sternum, with weak vesicular sound on that side, various signs of displacement of the windpipe, the lung, and the clavicle, dulness on percussion, and occasionally projection of some of the upper portions of the chest, generally most on one side, in which in cases of aneurism, and sometimes of other tumours, there is a double or single pulsation. This is not the place for entering into details with regard to the signs of sub-sternal aneurism: but we may remark that in more than

one case we have observed slight oppression of the breathing at a very early stage, before there were signs of bronchial compression; and we are disposed to attribute this, as well as the paroxysmal attacks of dyspnœa, occasionally occurring in the farther progress of aneurismal and other tumours in this region, to an irritation, of the vagus and its recurrent branch, which these tumours generally affect; and we agree with Dr. Stokes that the alterations of the voice are referrible to varying irritation of the recurrent nerve. But the laryngeal constriction is sometimes also complicated with inflammation, to which the air-tubes are particularly subject under the influence of aneurismal irritation. We lately witnessed a case in which a patient with a sub-sternal aneurism was at the point of death from spasm of the glottis with stridulous breathing, which afterwards assumed the form of acute laryngitis, and was relieved by free expectoration after venesection and the prompt administration of mercury. In two instances we have observed dyspnœa, or rather oppressed breathing, for a time in connexion with scrofulous enlargement of the lymphatic glands, manifest in those of the neck and axilla, and supposed to reach to the chest, yet without the hissing breathing in the trachea or the deficiency of vesicular sound in the lung, indicative of bronchial compression: the symptom here was probably from irritation of the pneumogastric nerve.

The treatment of tumours affecting the air-tubes is to be conducted on the general principles of counteracting as far as possible the irritation which they produce in the vessels, nerves, and muscles of the respiratory organs. Hence, according to symptoms, antiphlogistics, sedatives, and antispasmodics may be useful. Except in the case of enlarged lymphatic glands, it is of little use to attempt the cure of the disease itself. In that case a judicious course of alkalies and hydriodate of potash, with some mild tonic and sea air, will sometimes succeed in reducing the swellings, and removing the symptoms which they occasion.

PLEURISY.

Definition.—Pathological history, symptoms, and signs of acute pleurisy.—Symptoms and signs of the decline of acute pleurisy.—Chronic Pleurisy.—General symptoms.—Pathology.—Signs of absorption of the effusion.—Empyema—its symptoms, signs, and modes of termination.—Causes of pleurisy.—Diagnosis.—Prognosis.—Treatment of acute and chronic pleurisy, and of empyema.

PLEURISY, pleuritis, *πλευριτις* (*Hippocrates*), are names applied to inflammation of the pleura, the serous membrane covering the lungs and lining the thoracic cavity. The leading characters of this disease are, sharp pain of the side, dry cough, dyspnœa, fever, diminished resonance of the side, with ægophony followed by enlargement of the affected side and abolition of all sound of respiration and voice. But there is so great an uncertainty in the general symptoms, and variety in the physical signs, that a satisfactory knowledge of the disease can be obtained only through a study of its pathology: a short account of this will therefore simplify the history of the disease, and render more intelligible and available the description of its symptoms and signs.

Pathological history of Acute Pleurisy. The first known stage of inflammation of a serous membrane is an enlargement of the vessels in the sub-serous cellular texture: it is these chiefly that form the striated patches or points of redness

that are seen after death in the earliest stage of pleurisy, and their distention can be felt through the serous membrane, which seems slightly uneven on passing the finger over it. Perhaps at this period there is a diminution of the serous exhalation at the inflamed spot, as we know such to be the first effect of inflammation of mucous membranes, and probably increases the friction between the surfaces. Soon, however, the flow of serum is increased, and with it, if the inflammation continues, an albuminous matter (coagulable lymph) is exuded. This exemplifies the most simple form of inflammation. The vessels have no compound structure or secretion to complicate or modify their action; and we find their increased development attended by an exaggeration of those secreting functions which they fulfil in health. These functions are two-fold, viz., that of liquid exhalation and that of solid nutrition: the fluid exhaled is serum; the material of nutrition is the albuminous or fibrinous part of the blood. In their natural proportion these functions preserve the membrane in a healthy state, one merely lubricating its surface with a slightly albuminous fluid, the other nourishing and sustaining the solid matter of the membrane. But when these functions are increased in activity by acute inflammation, there is an overflow of their products, the liquid effusion is more or less rapid and copious, and the excess of the nutritive secretion now appears on the exterior of the membrane in various forms, and, either by itself or mingled with the liquid effusion, constitutes all the different products which are recognised as the results of inflammatory action. In its smallest proportion it is held in solution by the effused fluid, which on being drawn from the body, or after death, gelatinises from this fibrinous matter which it contains: where very abundant, it forms films or layers of lymph on the surface of the membrane; and this lymph is generally more abundant and disposed to speedy organization, when the inflammatory orgasm is strong, and the blood rich in nutrient matter.

Following still the pathological history of pleurisy, we find in the lymph the product of adhesions; but whether or not these adhesions take place, depends on the quantity of liquid effusion between the pleuræ. This effusion to a certain degree gravitates to the lowest parts of the chest, and in those parts tends to keep the membranes separate; and if the upper parts of the pleura be inflamed, they adhere the more readily, unless the liquid effusion be very abundant. But if the pleuræ be inflamed only in their lower portions, a moderate quantity of liquid is sufficient to keep them separate; and if the lymph then become organized, it forms not an adhesion but a false membrane coating the lung, which may have farther effects in modifying the remains or the products of the previous inflammation. Before we consider these various results of the modifying influences of time, of the degree and kind of inflammation, and of previous disease, on the pathological history of pleuritic cases, we shall take a view of the symptoms and signs of acute pleurisy.

Symptoms. These have been long considered as well marked by the sharp cutting pain in the side, restraining every common inspiration, and often making the act of coughing or deep breathing almost intolerable; the short breath which consequently results, the short dry cough, the general inflammatory fever, which with its antecedent rigour sometimes precedes the pain, but more commonly is developed with or after it, with hard quick pulse, heat of skin, flushed cheeks, and scanty high-coloured urine.

But it is now well known that there may exist extensive pleurisy and its consequences without this array of symptoms; nothing is more variable than the degree and combination in which they may occur. Pain of some kind is most frequently present; it is generally acute, circumscribed, and referred to below the breast or lower margin of the pectoral muscle; but sometimes it is lower down or shooting, or more diffused and less severe, and not seldom there is very little or no pain at all, but rather some soreness or tenderness on pressure between the lower ribs of the affected side. When the pleura covering the diaphragm is inflamed, the pain is generally acute, referred to the margin of the ribs and causes an unusual degree of distress and dyspnoea. This form of pleurisy is by no means commonly accompanied, as formerly supposed, by the *risus sardonius*

or delirium. The acute pain seldom lasts more than the first day or two, after which it may abate or entirely cease, although the inflammation continues, and the dyspnœa may increase with the accumulating effusion. The same remark is in some degree applicable to the fever, which is generally diminished in four or five days, assuming then a less inflammatory type. Sometimes it is very moderate, or of a remittent character; and this often happens when the effusion is most abundant. The degree of dyspnœa also varies much, being chiefly determined, first by the amount of pain, nervous sensibility, or catarrhal complication, and afterwards by the rapidity rather than the mere quantity of the effusion. The cough is a very uncertain symptom, being in some instances most distressing, in others altogether absent. In fact, so uncertain are all the general symptoms, that there are cases of what is called *latent pleurisy*, in which there may be scarcely a suspicion of the presence of disease of the chest, when pleuritic inflammation and its concomitant copious effusion have existed for many days or weeks. This is especially apt to occur in the course of fevers, or during convalescence from them, and in persons of weak or injured constitution; but it is occasionally met with in the healthy and robust.

The above-described symptoms may present themselves without pleurisy. Sharp pains of a nervous character not unfrequently closely imitate that of pleurisy, especially in hysterical females; and if they happen to be attended with feverish excitement, the resemblance is more complete. In fact, the greater number of symptoms commonly supposed to be distinctive of pleurisy, depend on a morbid sensibility of the pleura, which is by no means a necessary accompaniment of its inflammation; and the symptom of oppressed breathing, proceeding from the pressure of the effusion, may be marked only when this effusion has accumulated very rapidly, or when the other lung has been prevented by prior disease from supplementary exertion.

Physical signs. On the other hand, the physical signs in the greater number of cases are very unequivocal, and although they by no means mark the degree or the intensity of the inflammation, they seldom fail to announce its presence, and they pretty accurately measure its most serious concomitant, the liquid effusion. We shall first enumerate these signs in the order in which they commonly occur, and afterwards consider the nature and value of each:—

1. Diminished motion and sound of respiration from pain; 2. Sound of friction accompanying the motions of respiration; 3. Dulness on percussion in the most dependent parts of the chest from the effusion; 4. Diminished motion and sound of respiration from the same cause; 5. *Ægophony*; 6. Cessation of vocal vibration felt by the hand; 7. Cessation of *ægophony* and all sound of the voice; 8. Enlargement of the side; 9. Displacement of the heart, liver, mediastinum, and intercostal spaces; 10. Increased motions and sound of respiration on the sound side.

1. The respiratory movements are so far within the control of the will, that they are instinctively restrained in parts affected with pain; and it is obvious that the sound of respiration will be diminished in proportion. This has been noticed by M. Andral as an early sign of pleurisy; but it is evidently a very equivocal one, since it depends on the presence of pain, which is not constant, and which may exist quite independently of inflammation.

2. At the first onset of pleurisy a rubbing or creaking sound accompanying the movements of the chest is sometimes heard. This may be owing to a slight roughness or defective lubrication of the pulmonary and costal pleuræ at certain points, and, when combined with the general symptoms, may be considered a pretty exact sign; but it is very transient, and is seldom heard. It may be produced also by interlobular emphysema, in which case it lasts much longer. We are disposed to think that this sound is rarely produced by pleurisy, unless the lung be at the same time pressed against the chest by a tumour or by effusion, or partially distended by emphysema, or tuberculous or other deposits. The friction sound is commonly heard about the middle parts of the chest; it generally

ceases as soon as the sound of percussion becomes more extensively dull: but in dry pleurisy, and in the cases of partial pressure before mentioned, it may continue for a long time.

3. In by far the greater number of cases of pleurisy there is an effusion of serum, soon after the commencement of the inflammation; and the accumulation of this liquid in the chest is the cause of the signs by which pleurisy can be best distinguished. This fluid will accumulate first in the lowest parts of the chest, floating to a certain degree the lung upon it. Hence these parts will sound more or less dull on percussion, whilst the higher parts retain their usual resonance: change of posture, by changing the place of the liquid, will in some degree alter the situation of these sounds. As, however, the external vesicular structure yields more readily to pressure than the tubular parts within, the accumulating fluid soon mounts up in the form of a thin layer, between the lung and the ribs, to a considerable height in the chest. This thin layer slightly impairs the sound on percussion, and this more distinctly if the percussion be gentle and abrupt, as by flapping on a finger tightly applied, and comparing the sound with that of corresponding parts of the opposite side. This sign, as well as those to be next described, is liable to modifications from adhesions previously existing between the pulmonary and costal pleuræ: these we shall notice afterwards. As the effusion increases, the dulness becomes more complete and general, the infraclavian and scapular regions being generally the last to exhibit it. It often happens, however, that when even these are dull, there is some resonance in the axilla, transmitted through the fluid from the opposite lung. Sometimes, at a particular stage of the effusion, a tracheal or tubular sound is for a day or two heard on percussion below the clavicles and in the axilla, arising from the larger tubes which are not yet compressed.

4. The same accumulation of liquid must diminish the extent of the motions of respiration in proportion to its bulk, which has taken the place of the most expandible part of the lung. The sound of respiration will for the same reason be weakened, and its duration shortened in the affected side.

5. About the same time at which the dulness on percussion and diminution of the respiratory murmur reach the middle regions of the chest, there is a remarkable modification of the vocal resonance. It is heard much more distinctly than is usual in those regions; and it is superficial, as if produced in the spot, separately from the oral voice, and changed to a small bleating trembling note, which so much resembles the voice of a goat, that Laennec has well-termed it *ægophony* (*αἴζ*, a goat, and *φωνή*, voice.) This modification of the voice is heard most distinctly in the space between the third and sixth ribs, which corresponds to the middle-sized bronchial tubes: but near the spine it is generally mixed with a louder and more uniform resonance, which is common bronchophony, from the larger tubes at the root of the lung. Two circumstances are remarkable in *ægophony*: first, that the voice is more audible at the very spot where the lung is pushed away by the liquid, in consequence of the liquid by compressing the porous tissue of the lung enabling it to transmit better the sound of the voice from its interior. The second point is, that the voice is altered in character: this may be supposed to be caused by the nature of the matter which it has to pass through, a thin layer of liquid, which, being thrown by it into irregular vibrations, trembles and dances, now checking the sound, now transmitting it with increased force, so that the voice comes through tremulous and wiry. The high tones of the voice are best transmitted in this way, for the bass tones do not enter the small tubes, but if strong pervade the whole tissue with a diffused fremitus. Hence *ægophony* is best heard in women, children, and others, who have high voices. In persons with a bass voice it is more commonly limited to the lower angle of the scapula or near the spine, and from being seated in larger tubes takes more the character of buzzing bronchophony. As the liquid increases, the *ægophony* becomes weaker, more distinct, and loses much of its flutter or tremor, having rather the sound of a very slender deep-seated voice, or a silvery echo of

the original. This is owing to the lung being pushed so far away from the walls of the chest, and its tubes so much compressed; and as these conditions increase, the sound ceases altogether. It is not easy to determine what quantity of the effusion is enough to do this; but we are inclined to think that much sound of the voice is not transmitted when the layer of serum exceeds an inch in thickness, except over large tubes. If the ægophony remain stationary for several days, it is a proof that the effusion is moderate, and does not increase rapidly, which is a favourable sign: but it is often very transient, and many cases of pleuritic effusion are discovered after they have passed the degree which causes ægophony. Old adhesions will however modify this, as well as the other physical signs. When ægophony is most distinct, it is often coupled with bronchial respiration, especially between the scapulæ, where also there is a good deal of common bronchophony mixed with it. M. Reynaud has lately confirmed the original opinion of Laennec, that ægophony is a kind of bronchial voice modified by its transmission through a layer of liquid. He observed in a pleuritic case, that the ægophony heard at the lower angle of the scapula when the patient was sitting, became changed to simple or louder bronchophony when the patient stooped much forward or lay prostrate, this change of posture permitting the liquid to gravitate to the anterior part of the chest, and floating the lung into contact with the parietes. Ægophony and bronchophony are different enough when their characters are well marked; but they often present mixed and doubtful varieties, that do not admit of any such easy distinction. As far as description will go, we would represent the true character of ægophony to be a certain tremulousness in the voice when it is superficial, and an echo-like slenderness when it is deep-seated; whilst bronchophony may present many other varieties.

Ægophony is by no means a certain sign: when present it is of great value, but it is often wanting throughout a large part of the disease: and in practice is, therefore, of comparatively little value. G.

6. An early and very characteristic effect of the accumulation of liquid in the pleural sac, is its intercepting the diffused vibration of the voice, which is usually felt by the hand applied to the chest. A layer of liquid muffles and destroys this vibration; and it may do this even when ægophony is audible at the same spot, the vibrations of the latter being too fine to be felt by the hand. This affords a distinction between a liquid effusion and a consolidation of the lung, for the latter transmits the vocal vibrations with unusual force from the tubes. This diagnostic sign we owe to M. Reynaud; and it is more valuable because it is easily obtained, even by a person who does not practice auscultation. It must not, however, be always considered as quite conclusive, for there are some exceptions to it, both positive and negative. For example, in case of partial adhesions of the lung to the chest, even more vibration than usual may be felt at the adhering parts, where the lung and its tubes are pressed into close contact with the walls of the chest: it may happen, on the other hand, in consolidation of the lung, that liquid or other obstruction in the bronchial tubes may prevent the voice from being transmitted through them.

7. As the liquid effusion increases, the ægophony and all sound of the voice cease throughout the affected side, except within two or three inches of the spine, and in spots where the lung may have been adherent, which frequently happens at the upper parts of the chest. The sound of respiration is also abolished in most parts, but never in the interscapular region, and rarely under the clavicle and in the axilla: it is, however, much weaker in these parts than on the sound side, and may probably be only transmitted from that side.

8. Enlargement of the affected side is another sign to be noticed. The effusion must be pretty copious to render this enlargement perceptible; but a difference between the two sides of the chest may sometimes be seen on inspection

of the chest in different periods of respiration when the quantity of liquid is not very great. The affected side is first seen to be larger at the end of expiration, when it does not diminish equally with the other side, especially at its lower portions. So, on encircling the chest with a piece of tape, fixing it at the sternum and at the spine, it will be observed to tighten and slacken with inspiration and expiration more obviously on the sound than on the diseased side, which remains more fixed in a state of partial distention. As the effusion increases, the difference is perceptible through the whole respiratory act, and the eye can easily detect the want of symmetry, whether the inspection be made in front, behind, or from above, looking down on the patient's shoulders. To be more exact, however, the chest should be measured with a tape or riband passed horizontally around the chest, and made to meet at the centre of the lower end of the sternum; then taking it off by the point where it crosses the spinous processes of the vertebral column, the length of the two sides may be compared. In making this comparison it must be recollected that the right side in the healthy state is from a quarter to half an inch larger than the left. Laennec remarked that the enlargement of the side is sometimes discoverable by the eye as well as by measurement, two or three days after the first attack of pleurisy: but it does not generally proceed afterwards in proportion to the effusion until this becomes excessive, and has displaced the adjoining parts to a great extent.

9. A very important class of signs arises from the displacement of certain of the walls and organs bounding the effusion. Laennec remarked that the intercostal spaces on the affected side do not present their usual depressions, and are sometimes, especially in chronic cases, even prominent beyond the surface of the ribs. This had been noticed by surgical writers in empyema. It is scarcely perceptible, however, in acute pleurisy, unless the subject be thin. In such cases we have seen the intercostal spaces not only prominent, but presenting also an evident fluctuation. In looking for this sign, the patient should be placed obliquely with regard to the light; and it may be more readily seen by surveying the chest from a little distance, than by a closer inspection.

But we may generally learn more from the displacement of the organs adjoining the effusion, especially the heart and the liver. Laennec barely noticed these displacements. To Drs. Stokes and Townsend we chiefly owe their application to the diagnosis of liquid effusions in the chest. The displacement of the heart by an effusion in the left pleura, is the most valuable and easily recognised of these. In this case the pulsations of the heart are felt and heard most distinctly under or to the right of the sternum, or in the epigastrium, instead of, as usual, between the cartilages of the fourth and sixth left ribs. On the other hand, a very abundant effusion on the right side will push the heart so far to the left, that it may be felt beating below the left axilla. But in this case the more remarkable displacement is that of the liver, which by feeling and percussion will often be found far below the margin of the ribs. Sometimes it forms a distinct tumour in the abdomen; and we have known more than one case of latent pleurisy, in which this tumour was long supposed to be the chief disease, the patient not complaining at all of the chest. Dr. Stokes has published some interesting observations with the view to prove that the displacement of the diaphragm and intercostal muscles in great measure depends on paralysis of their muscular fibres, the result of the inflammation of the pleura which covers them. The displacement of the mediastinum is to be discovered only by percussion; situated as this is naturally in the mesial plane, it divides the two cavities of the pleura at a line down the middle of the sternum, which bone sounds well on percussion from the margins of both lungs which lie under it. But a copious effusion will push the mediastinum towards the opposite side, and, by occupying the whole space behind the sternum, will give this bone a dull sound on percussion, and this may even extend half an inch or an inch beyond it. All these displacements may also be produced by an accumulation of air in the pleural sac, but the tympanic sound on percussion would at once distinguish this case.

10. In all cases of physical examination, the two sides must be examined with the view to comparison; and in case of pleuritic effusion it will be found, that the sound side will give not only the negative proofs of the absence of disease in it, which may well be compared with the positive signs of disease on the opposite side, but it will even show an exaggeration of the signs of healthy action, in consequence of its work being really increased. Thus, whilst the diseased side is almost fixed, the healthy side will be seen to move more fully and quickly than usual, and the sound of respiration will be increased in a remarkable degree, so as to resemble the loud respiration of children; hence it is called *puerile*.

We have before noticed that the physical signs of pleurisy are liable to be much modified by old adhesions, which bind the lung to the walls of the chest. When the adhesions are loose, they only form bands or cells distended with fluid; and, keeping the lung at a moderate distance from the walls of the chest, they may render the continuance of ægophony much longer than it would be without them. When an adhesion is so close and strong that the accumulating fluid cannot separate it, the lung is there compressed against it; or if there are several adhering points, the attachments to these are preserved by so many pillars of compressed lung at these adhering parts; if they be at the upper or middle regions of the chest, instead of a total abolition of the voice and respiration, there may be loud bronchophony and bronchial respiration, transmitted from the large tubes by the adhering dense column of lung. Sometimes the adhesion is to the diaphragm or mediastinum; and it may then prevent or modify the displacement of these parts by the fluid. Not uncommonly the adhesions are more extensive and close, especially to the upper parts of the chest, and then the lung is pressed by the effusion from below against the whole of the upper walls of the chest. In this condition it may still admit air, and be quite resonant on percussion; but as much of its vesicular structure is compressed, the sound of respiration there will be tubular or bronchial, and a noisy bronchophony will be transmitted by it to the whole upper region of that side. We have often heard the voice and respiration quite tracheal from this cause. The displacement of the heart and liver, the prominence of the intercostal spaces, and the dulness on percussion of the whole lower portion of the sternum, together with the immobility and enlargement of the lower part of the affected side, will generally distinguish the true nature of these cases. Much more rarely the lung adheres closely to the whole of the lower part of the chest, and the effusion occupies the upper. In such cases there may be pulmonary resonance in the lower parts, with obscure sound of respiration. The upper may be dull in the situation of the effusion; but sometimes, from the top of the sternum to the middle of the clavicle and below it, there is a remarkable amphoric or tracheal resonance, with some respiration of the same character, yielded by the large tubes through the effused fluid. The character and production of this sound may be illustrated by filipping on a finger pressed against the trachea when the mouth is open. The windpipe passes under the sternum, and divides into the two great bronchi, which spread between one and two inches below the clavicles. Here in health the porous lung lies over these tubes, and intercepts their resonance on percussion; but if this be perfectly condensed by liquid effusion, or perfectly consolidated by hepatisation, the hollow note of the tubes will be produced on percussion, just as it is over the windpipe, where no lung intervenes.†

Symptoms and signs of the decline of Acute Pleurisy. The general symptoms seldom maintain their acute character for many days. The stitch in the side ceases, or is felt only in a long breath, or in coughing; sometimes, but not always, accompanied with soreness. The cough, if there be any, generally continues, and becomes bronchitic. The pulse sometimes loses its hardness, and is reduced in frequency; in other cases, particularly when the effusion is very copious, it remains as quick as ever, although it may be weaker. The difficulty of breathing is perhaps less apparent, but the frequency is often not diminished, whilst the effusion is unabated, although the patient is scarcely sensible of it. In other cases again, in the course of a few days, the breathing returns nearly to the

natural state, although one side of the chest is full of fluid. In almost all cases, lying on the healthy side embarrasses the breathing, both by restraining its movements and by causing the fluid to press against the heart, and the sound lung. For the same reason, pressure on the abdomen may cause little uneasiness on the diseased side; but on the sound side, by impeding the descent of the diaphragm, it produces a feeling of dyspnœa, even when none may be otherwise present. Not uncommonly after the first few days of the disease, when the acute symptoms have in great measure subsided, the patient complains of nothing but weakness, and calls loudly for an improved diet. It is especially in such cases that we must be in great degree guided by the physical signs: if these indicate that the effusion is undiminished, or even increasing, we may be sure that the inflammation is not subdued, but only latent. But if, from an improved resonance on percussion, and returning movement and sound of respiration, first in the upper parts of the chest, as well as a diminution in the volume of the affected side, we find that the liquid effusion is on the decrease, we may judge that the inflammation is subdued, and that its products will gradually be removed. The reabsorption of the fluid sometimes takes place in the course of two or three weeks; and in that case ægophony returns when the layer of fluid is thin enough to permit the vocal resonance to pass through it, but more commonly the fluid is not dispersed for a much longer time. Laennec remarks that an effusion which has been formed in the course of a few days is sometimes not entirely removed at the end of six months; and we can add our testimony to the truth of this observation. In such cases the return of ægophony is very uncertain: in fact the signs are rarely watched during so long a period, and the patient may cease to be the subject of medical treatment before the effusion is sufficiently reduced to give transmission to the voice. In very moderate cases the liquid is absorbed before the lymph or albuminous matter is removed; and when the pleural surfaces covered with this come together, a sound of rustling or rubbing is sometimes heard with the movements of respiration: but this soon ceases, as the lymph is converted into adherent bands of false membrane. Now if these false membranes are formed after the liquid has been removed, and the lung has recovered its full extent of expansibility, they are adapted to its free motions, and do not to any material extent interfere with them. Hence in dead bodies we often find adhesions which are lengthened in the lower parts of the chest, where, from the action of the diaphragm, the lungs descend as the ribs rise, whilst in the upper parts the adhesions are short, because the lungs there follow more exactly the movements of the walls of the chest.

But in more severe or obstinate cases, which are not uncommon, the inflammation continues after the liquid has been abundantly poured out, and not only increases and perpetuates this liquid effusion, but also throws out albuminous matter in various conditions, which by its present qualities, or future changes, may produce a variety of prejudicial effects, all tending more or less to interfere with the perfect restoration of the organs to a healthy state. These, and the signs and symptoms which they produce, may be better considered under the head of chronic pleurisy; for although inflammation in which they originate may often be acute at the first, yet the course and character of these changes are quite of a chronic description.

CHRONIC PLEURISY.

General symptoms. There is less reason for distinguishing formally between acute and chronic inflammations of the pleura, because the transition of the one to the other is really not defined; and the symptoms of the recent disease sometimes have so little of an acute character, whilst that of a long duration occasionally manifest such an intensity of irritation, that the terms acute and chronic are less applicable to pleuritic affections than to inflammations of most other organs. We can see some reason for this in the fact, that the pleura, being a short sac, is liable to have its acute inflammation converted into chronic by the retention of its pro-

duct; and chronic pleurisy is liable to be excited into an acute state by the distending or irritating influence of the effusion. Still differences are very apparent in many cases, in the prevalence of high inflammatory fever in some, and in there being no fever, or one of a hectic kind, in others; in the sthenic condition of the circulation in some, and its weak depressed state in others, whatever be the degree of pain or nervous irritation accompanying them. Thus it may happen that an acute inflammation with all its prominent symptoms has been apparently subdued; but the effusion remaining undiminished, the disease goes on in a latent form, until, from some imprudence on the part of the patient, who supposes himself cured, an attack of dyspnoea, or a stitch in the side, again lays him on his bed; and although these symptoms may generally be mitigated, they then leave those more peculiar to chronic disease. Of these a remittent or hectic fever, with permanently quick pulse; gradual emaciation; shortness of breath, particularly on exertion; inability to lie on the healthy side,—may be mentioned as the most common: occasionally there is cough, and there may be purulent expectoration from a concomitant chronic bronchitis, and various degrees of pain in the affected side; but these symptoms are very uncertain. A chronic form of pleurisy is sometimes developed gradually without being preceded by a distinct acute attack; but it is probable that many of these cases are at first acute in a latent form, the patient having been supposed to suffer merely from a cold, or a slight feverish attack, during the acute stage of the disease, and the local symptoms not attracting attention until they have become more developed in the chronic form.

Pathology. In tracing the signs and complications of the more chronic forms of pleurisy, we shall be enabled to exhibit them more concisely and intelligibly through a rational view of their pathology, as we have studied it in the signs and anatomical effects.

Besides serum and coagulable lymph in their simplest forms, which may be speedily removed and organized, inflammation, particularly the more chronic kind, may generate the following products, which are less readily removed, and which tend more or less to interfere with the restoration of the organs to a healthy state.

1. Healthy and highly organizable lymph, when deposited in a thick layer, must in some degree restrain the expansion of the lung, and thereby retard the absorption of the fluid. This lymph may be diminished by absorption; and the membranes formed of it may ultimately adapt themselves to the full expansion of the lung: but there will be less chance of this in proportion as the liquid effused is copious, and its removal slow.

2. In cases similar to that just mentioned, but with a lymph less organizable, the product of a less active inflammation, or in which there is much of the colouring matter of the blood (but not in this case only, as Laennec supposed,) its organization is more tardy, and the membrane resulting is of a more rigid and less yielding nature; consequently the lung is more permanently confined in its compressed state. The membranes which are formed on the pleura in these cases are sometimes quite cartilaginous in density, and of considerable thickness; and occasionally they are found, in process of time, partially ossified. If these acquire their density before the liquid is removed, it is clear that they must for ever bind down the lung: but we have seen cases in which there have been signs of farther contraction after the absorption of the liquid, which may be ascribed to the tendency which some newly-formed tissues have to contract for some time after their production. This is exemplified in the contraction of the cicatrices of burns of the skin, and of the false membranes, lining cavities of the lung; and in other cases, where false membranes have been slowly formed, and tend to assume a fibrous or fibro-cartilaginous rather than a serous or cellular structure.

3. But the inflamed pleura may effuse lymph of still lower vitality, susceptible of but imperfect organization, and wholly incapable of throwing out more of an organizable character: hence, when the pleura is coated with it, if the inflamma-

tion continue, the overflow of the nutritive secretion will be in the form of a curdy matter, or of mere loose shreds of solid albumen.

4. The solid matter may be thrown out in a disintegrated state, utterly insusceptible of organization, and diffused through the fluid in flakes or particles forming a mixture more or less resembling pus, which is the fluid of empyema. Although in many instances this is the result of a more chronic form of pleurisy than that which forms lymph, and owes its persistence and tendency to increase to the want of vitality in its solid matter, yet we do meet with cases of empyema which arise from very acute forms of inflammation. In these instances the fluid is more strictly purulent, the solid matter being in the form of globules, like those of pus; and seems to be the result of what may be called a suppurating diathesis; in consequence of which, all the albuminous products of inflammation tend to assume a purulent character. In such a case we have seen pus within a fibrinous clot in the heart; and it is difficult to avoid the supposition that it is something in the condition of the blood that determines this less usual product from the acute inflammation of a serous membrane. It is well known that the continued access of air will cause the inflamed pleura, as well as other internal textures, to secrete pus instead of lymph; hence whenever pleurisy is excited by the perforation of the lung, the liquid poured out is more or less purulent.

5. Lastly, as the solid accretions on the inflamed pleura, we may find the various morbid productions called tuberculous, scirrhus, encephaloid, and melanotic; these being commonly the result of some constitutional taint developed by the local inflammation; but in the case of the first and last, probably sometimes the product of peculiar modifications of the inflammation itself.

It is not to be supposed that the products of pleurisy in every case belong exclusively to one of the kinds now described, or that they are so simple as to be rigidly divisible by any such classification. We rarely examine a case of protracted pleurisy after death, without finding traces of several forms of the products of inflammation; and a comparison of many discovers that these pass by insensible gradations into one another; so that, although we may meet with some that are clearly referrible to one class of products, there are others of a mixed or intermediate character. If we reflect on the consequences of all these products of prolonged inflammation of the pleura, we must perceive that they all tend to keep down the lung in that compressed state to which it was reduced by the first effusion; and they do this by the rigid false membranes which are formed when the solid effusion is susceptible of organization; and by the persistence of the liquid effusion when the solid matter is destitute of organization, and acts as an extraneous irritant. We must suppose, too, that the absorbing properties of the pleura must be altered by the long continuance of disease; and that various lesions are propagated to the adjoining tissues, which, however they may have escaped the immediate effects of inflammation in its acute form, can scarcely fail to be affected by the slow and less limited influence of chronic inflammation. Hence the parenchyma of the lung, the bronchi, the pericardium, the bones and cartilages of the chest, occasionally become the seat of various changes; thus, the lung becomes at first consolidated, and afterwards atrophied; the tubes secrete pus, and become dilated; the pericardium forms adhesions to the heart, and becomes thickened; and in cases of empyema, the ribs, vertebræ, and their cartilages, may become carious. Nor must we forget the unfavourable operation of the disease on other functions, the obstruction to the circulation by pressure on the pulmonary and adjoining vessels, the abridgment of the function of the lungs themselves, and the irritating or depressing influence occasionally extended from the seat of lesion to the various organs of the abdomen. In fact, besides the injury done to the respiratory organs, an imperfectly cured pleurisy may in an insidious manner oppress the whole system, and bring it into an anomalous cachectic state, in which morbid conditions of various kinds may be produced or brought into activity. Thus we have met with several instances in which tuberculous disease was first

developed after pleuritic attacks, and in two instances we have found the tubercles confined to the uncompressed lung, indicating that their development was posterior to the compression of the other lung, in which their deposition was mechanically prevented.

For practical purposes it will be convenient to divide the preceding results of pleurisy into two classes:—1. Those in which absorption ultimately predominates over effusion, and the liquid is gradually removed; and 2. Those in which the effusion predominates, and the liquid can only be removed through a perforation of the pleura.

Signs of absorption of the effusion. In the first of these, as the absorption of the fluid proceeds, what is it that supplies its place? The lung, as we have seen, may be either so bound down by rigid false membranes, or so condensed and obliterated by long-continued pressure and inflammation, that it is not susceptible of its former expansion to effect this purpose. In the great majority of cases, as the liquid is absorbed, the walls of the chest are contracted or collapsed, so that the diseased side, which at the height of the effusion measured perhaps an inch or two more than the healthy side, now gradually becomes considerably smaller, sometimes to the extent of two or three inches. The contraction is first perceptible in the upper part of the chest, and with the depression and more fixed condition of the shoulder contrasts remarkably, on inspection, with the full development and active motions of the sound side. On examining the contracted side more narrowly, we see, in detail, that the ribs are lower at the sides and closer together, the scapula more prominent and nearer to the spine; and sometimes the sternum, and occasionally even the spinal column also, are curved concave towards this side. In all this we see the results of the atmospheric pressure, together with un-antagonized muscular efforts, acting on the walls of the chest. The same pressure tends to fill the cavity from the abdomen: thus the diaphragm is pressed permanently upwards, carrying with it the mass of the liver on the right side, and the resonant stomach on the left; and on watching the abdomen, it is not seen to swell on that side, as on the other, at each inspiration. In some cases, too, the same pressure is exerted within the chest from the sound side, causing displacements the very reverse of those which had been occasioned by the pressure of the previous effusion. We have seen many cases in which the healthy lung had displaced the mediastinum towards the contracted side, not only under the whole sternum, but even under the cartilages of the ribs to the extent of an inch beyond it; so that these parts sounded well on percussion, and the intercostal spaces there showed movements of respiration which scarcely affected any other part of that side. Dr. Stokes has recorded a case in which, after the absorption of an effusion on the right side, the heart was drawn over to that side, so that its pulsations were felt to the right and not to the left of the sternum. We have met with three examples of this kind, in which the heart became permanently displaced to the right. We have also seen, after the removal of pleuritic effusion on the left side, the heart drawn upwards to the left, so that its pulsations were distinct from the fifth to the third rib, near the axilla. Dr. Stokes describes a case in which, after an acute effusion on the left side, which displaced the heart to the right of the sternum after the removal of the effusion, the heart remained loose, falling from one side of the sternum to the other, according to the position of the body.

We proceed to describe the signs obtained by auscultation of a side contracting after chronic pleurisy. In many cases where the effusion has been copious and of long standing, the sounds of respiration and percussion continue permanently imperfect, although the liquid be completely removed; and in almost every case they are more or less impaired for months after the attack; in fact they correspond pretty well with the appearance and diminished motion of the affected side, and are to be referred to the same causes. The improvement is generally to be found first in the upper part of the chest, and near the spine. With the return of a weak respiratory murmur, and slight resonance on percussion, some degree of vocal resonance may also accompany the removal of the liquid in the upper parts of the

chest, amounting to loud bronchophony, often accompanied by a remarkable *buzz*, in other parts being merely the diffused vocal fremitus, according to the size of the bronchial tubes and the degree and permanency of their compression. This is one of the instances in which some physical signs may deceive us, unless attention be paid to all, and to the general history of the case; for if, for the first time, we see a patient with the above signs, and he happen to have bronchitis, we may be led to believe that the resonance of the voice and the dulness are caused by consolidation from recent inflammation of the lung, or from tubercle; but this error may be avoided by attending to the history of the case, and the signs of contraction that characterize it. The dulness on percussion in the contracted chest is less owing to the absence of air, than to the compressed, drawn-in condition of the walls, which are no longer free to vibrate; and although there be air in considerable quantity in the lung underneath, this air gives no spring to counterbalance the atmospheric pressure, which is continually acting as a dead weight on the contracted side. Sometimes more sound may be obtained by pressing the fingers strongly on the side, and then striking on them; this pressure brings the walls beyond the unequal atmospheric weight, so that they may then vibrate more freely, as we have formerly explained.

We find, then, that in these cases of pleurisy the condition of the side of the chest was, at the period of the copious effusion, the reverse of what it becomes when that effusion is removed; then it was dilated, and the adjoining parts pushed from it; now it is contracted, and the adjoining parts drawn into it. Is there not, then, an intermediate stage, in which neither of these conditions is presented, and the side has the usual shape and dimensions? Our experience leads to the conclusion that there is not; but that the transition from one condition to the other is not generally uniform, but partial. The common case is that the contraction begins in the upper part of the chest before the dilatations and displacements have ceased in the lower; and it seldom happens that there is not, during the diminution of a pleuritic effusion, an irregularity in the shape of the chest, a comparative bulging of the lower portion, which may serve to distinguish it from consolidation of the lung.

In the cases hitherto considered, the effusion has been supposed to be general and to fill the cavity of one side of the chest; and the contraction after its removal, although irregular, to be also general. In case of partial effusions limited by rigid adhesions to transverse portions of the chest, it is plain that the thoracic walls cannot contract enough in those parts to obliterate them. In the few cases of this kind which we have seen, there had been partial contraction; but the space occupied by the effusion was chiefly filled either with air, or by the adjoining viscera pushed in, or with a semi-solid curdy fluid, probably the inspissated remains of the effusion.

It might be supposed that individuals, whose lungs are reduced, by contraction of the chest after pleurisy, to little more than half their natural size, would be reduced to a very frail state of health and a low scale of bodily strength; yet it is curious enough, that some such individuals have continued to enjoy good health, and to be actively engaged in the pursuits of life. Laennec mentions the case of a distinguished surgeon of Paris, who, although he had one side contracted, in a very marked degree, from an attack of pleurisy in his youth, yet enjoyed excellent health, and was in the habit of lecturing twice a-day without inconvenience. We have met with a few instances of the same kind, but they were in young subjects in whom the walls and organs of the chest are capable of more extensive adaptation than in after life, and in no such case have we found the contraction excessive, nor the respiratory murmur nearly abolished. In other cases (and they are, we believe, the most common) extensive contraction of the chest causes such an habitual shortness of breath and tendency to palpitation, as to incapacitate the subject from active exertion, so that even slight bronchial attacks, or febrile excitement, cause severe and distressing dyspnoea. We have farther had occasion to observe, that before the system becomes accommodated to

the abridgment of respiration which this lesion produces, and even afterwards, under unfavourable circumstances, there is an enfeebled or cachectic state of the whole frame, in which various trains of disorder may arise; and unless care be taken to counteract them by remedies and circumstances most favourable to the general health, scrofulous or dropsical disorders may be engendered, and develop new mischief in the respiratory organs or elsewhere. Although, therefore, we may look on contraction of the chest as a mode of curative termination of pleurisy, it is one of the least favourable kind, and liable to many detracting circumstances.

EMPHYEMA.

The other class of cases in which effusion preponderates over absorption, and the liquid can only be removed through a perforation of the pleura, comes next to be considered. This character is to be traced in some instances to the condition of the membrane, which, either from its continued inflammation, or from change of its structure, secretes more than it can absorb: sometimes the accumulative tendency of the effusion may arise from some obstruction in the circulation, dependent on disease of the heart or great vessels, on tuberculous or other consolidation of the lungs, or even on the partial pressure of the effusion itself. But the more common cause of increasing effusion is in the nature of the matter effused, which when of a purulent character is not readily absorbed, and constitutes the *Empyema* of authors.

The *symptoms and signs* of empyema are generally those already described as indicating extensive liquid effusion, but they may be modified by the length of time that effusion continues: thus, although the feeling of dyspnœa, and perhaps the fever, may have abated, even with the effusion on the increase, yet the general disorder of the system, and the signs of enlargement of the side, and displacement of its usual boundaries, commonly become more marked. It is by no means constantly observed that the effusion of pus is peculiarly marked by the occurrence of rigours, hectic fever, or more constitutional disturbance than that which attends the effusion of mere serum and lymph; but when such symptoms do occur, there is a probability in favour of the effusion being truly purulent. The long-continued pressure, perhaps joined, as Dr. Stokes has suggested, with the paralyzing influence of prolonged inflammation, causes the muscular portions of the walls to yield to an increased extent; hence the intercostal spaces become more prominent, the diaphragm farther pressed into the abdomen, carrying with it the adominal viscera. Thus on the right side the liver may be pressed down to the umbilicus and ilium, causing a protuberance there, which has not unfrequently been mistaken for the chief disease. On the left side, the stomach is not generally so much displaced, but the diaphragm is pushed down more behind, carrying with it the spleen and the colon, the pressure on which sometimes seems to cause flatulent distention of the abdomen. In a case of this kind which we have recently witnessed, the enlargement of the chest was entirely behind, the left infra-mammary region not being at all full, and giving the resonance of the stomach, although the heart was displaced to the right of the sternum.

When the effusion is purulent, there is not uncommonly associated with it an ulcerative process, which may permit the matter to escape through the lungs, the walls of the chest, or the diaphragm, and which, in cases of long continuance, often involves other parts besides that through which the matter is evacuated. Thus, after death we often find small excavations in the layer of semi-organized lymph coating the walls of the chest, and in some instances this ulceration perforates the pleura and a layer of intercostal muscles, without proceeding farther. In other cases the ribs, vertebræ, or sternum, become partially carious from the same cause. When this ulcerative process proceeds so far as to cause the matter to point externally, a soft fluctuating swelling is felt at some part of the chest; and it may generally be known to communicate with the interior of the chest by

its becoming tense during expiration, and softer during inspiration. Not uncommonly the matter burrows under and between the muscles and integuments of the chest, and points at several places, and at a distance from the perforation of the pleura. We have seen abscesses connected with empyema point in three instances under the pectoral muscle, once in the right hypochondriac region, and once close to the spine: that in the hypochondriac region had been mistaken for an abscess of the liver; in this case it was found after death that there were perforations of both intercostal muscles and diaphragm; and between the layers of the latter, the matter passed to the margin of the ribs, and there spread under the integuments, communicating with the other perforation between the ribs. The superficial abscesses are sometimes accompanied by much local pain and tenderness; but in some cases these are scarcely complained of. These abscesses are generally slow in opening spontaneously: they generally first spread between the muscles and integuments, causing a puffy state of the parts. When the opening does take place, there is a discharge of matter, more or less copious; and this recurs from time to time, especially during any strong efforts of expiration, as in coughing. Sometimes air is drawn at the orifice during strong inspirations, and the next jets of matter issue with greater force, occasionally mixed with bubbles of air. After the air has gained access to the empyema, the pus, which was at first inodorous, generally in a few days becomes fetid, exhaling the odour of sulphuretted hydrogen: and with this change in the discharge, there is increased constitutional disturbance, sometimes manifesting itself in form of irritative fever, with bounding pulse and heat of skin, alternated with colliquative sweats; sometimes producing typhoid symptoms, and a state of general depression.

When the matter of empyema is discharged by ulceration through the lungs or bronchi, there is a violent fit of coughing almost like vomiting, ending in the expectoration of large quantities of matter. These efforts sometimes threaten suffocation: but the discharge is followed by considerable abatement of the symptoms. Laennec considered this a more common event than perforation of the walls of the chest: our own experience would indicate the contrary; but there are on record many cases of both results. The ulceration through the substance of the lung or air-tubes is described by Dr. Townsend to be accompanied by the formation of a gangrenous eschar, which is detached, and the fistulous passage is lined with a false membrane, which prevents the matter from spreading through the lung, and conducts it to the air-tubes.

The evacuation of the matter by fistulous openings may go on continually, or recur from time to time, with more or less temporary relief, for weeks, months, or even years: the patient in some instances recovering, in others sinking from the continued effects of the disease. In the former case, the discharge soon becomes less, and entirely loses its fetid character; the wound heals, and the chest gradually becomes contracted in the manner before described, there being a partial return of respiration in some portions of the chest.

Causes of pleurisy. We are not aware that any circumstances predispose to pleurisy farther than those which render the body liable to other inflammations, such as a relaxed or debilitated state of the system after fevers or other severe disorders, the puerperal state, &c.

Of the *exciting* causes of pleurisy, cold is by far the most common, especially exposure to cold winds; hence it is observed to prevail especially in the month of March. It may, however, be excited by external injuries, such as wounds and contusions of the chest, fractured ribs, &c.: in these cases the disease is not uncommonly latent, and becomes chronic. It is an occasional complication of continued and exanthematous fevers, particularly in some epidemics, constituting one of their dangerous complications. Less frequently it is excited by gout or rheumatism; and on the sudden removal of a cutaneous eruption, or healing of an old ulcer or other habitual drain. It sometimes occurs from the extension of inflammation from the lung, the peritoneum, or the walls of the chest. From the latter cause, it not unfrequently forms the closing scene in cancer of the breast. It

is occasionally associated with erysipelas, diffuse inflammation of the cellular tissue, inflammation of the veins and puerperal fever; in such cases it is usually latent, and accompanied by the typhoid symptoms common in those formidable diseases. It is not uncommonly excited by tubercles in the lung, both in their solid state, and after they have been softened. In the latter case, when the pleura is perforated, there is generally, also, the admission of air into the pleura, producing the complex lesion, pleuritic pneumo-thorax, to be afterwards noticed.

Diagnosis. In its very earliest stage, at the first attack of pain, pleurisy may be mistaken for pleurodyne and nervous pains of the chest and upper part of the abdomen; and as there are rarely any distinctive physical signs at this period, we must seek for the character of pleurisy in the general symptoms of fever, heat of skin, and sharp hard pulse, and sometimes in the short dry cough which accompanies it. In a short time, however, the physical signs become the most characteristic marks of the disease. It is unnecessary here to repeat the description, and it only remains to point out the signs which distinguish pleurisy from some other lesions that most resemble it. Consolidation of the lung differs from pleurisy in its not causing any displacement of the contents or walls of the thorax, and generally, also, in its increasing the vocal resonance of the affected side, whether heard, or felt by the hand; and by its leaving some sound of respiration which is generally of a bronchial character. Partial pleurisies confined by adhesions are less easily distinguished, because, where the lung is adherent, there may be as much bronchophony and respiration as in cases of consolidation; but on examination these will be found to be more circumscribed than in the latter case, all sound being absent in other parts, which farther present the signs of enlargement or displacement of the heart, liver, or mediastinum, with fulness of the intercostal spaces, generally more remarkably than usual. A similar irregularity in the shape of the chest will serve to distinguish pleurisy in the progress of cure, by contraction of the chest, from the case of a consolidated lung. The diagnosis of intra-thoracic tumours will be described under their head.

Chronic pleurisy is liable to be confounded with tuberculous phthisis, for their general symptoms are often very similar; and in truth they sometimes co-exist, or run into one another. But their physical signs sufficiently separate the two kinds of lesion; there never being in phthisis that general dullness and absence of respiration, with enlargement of the side and displacement of parts, which occur with empyema. The expectoration in chronic pleurisy is sometimes purulent without any communication with the pleura, or disease in the substance of the lung; it is in fact the product of a bronchitis which generally accompanies the last stages of most diseases of the chest. From simple bronchitis, dilated air-cells and tubes, and other chronic affections of the chest, the distinction of pleurisy through its physical signs is sufficiently evident. Its diagnosis from hydrothorax will be afterwards pointed out.

Prognosis. Simple acute pleurisy, although a serious disease, and full of danger when neglected, generally yields to remedies promptly employed before the effusion is copious. But if active measures have been delayed or insufficiently used, or if the effusion be purulent, or if there be other diseases in the chest, such as organic lesions of the heart, liver, or kidneys, or tuberculous or other deposites in the lungs, pleurisy often becomes an intractable and even fatal disease. It does not commonly prove fatal in its acute stage from the quantity of the effusion, except when the disease attacks both pleuræ at once, or in cases in which empyema, or some previously existing disease in the other lung, prevents its free expansion to supply the defect of that which is compressed. The very rapid accumulation of the effused fluid is generally an unfavourable sign; for experience has proved that in such a case its dispersion is more difficult. When the acute symptoms have subsided, and the extreme oppression resulting from the first effusion has abated, the probable issue of the case will depend much on the condition of the general health and strength. If this continue pretty good, there is reason to hope that the effusion will be gradually removed;

and this hope becomes more sure as soon as the sounds of percussion and respiration are heard returning to any part, however small, in which they had been previously absent. But if the weakness of the body increase, and some of the functions be more or less disordered, the urine scanty and high-coloured, the legs or surface œdematous, or the expectoration purulent, with night sweats and increasing emaciation, there is much reason to fear an unfavourable issue, either from the nature of the effusion or the want of power to effect its absorption before it fatally oppresses the vital functions. In case of empyema, where the purulent matter makes its way into the bronchi, or through the walls of the chest, although its discharge may give considerable relief for the time, yet the improvement may be but temporary; and here also the ultimate result will much depend on the general health and strength, as indicated by the rational symptoms, as well as on the condition of the lungs and other organs. Where these circumstances are favourable, a permanent cure may follow; or the spontaneous discharge continuing to a greater or smaller extent, a tolerable share of health may continue for months and even years. But not uncommonly, before the matter finds its way externally, it has produced serious mischief in other parts, and by totally destroying the irritability of the intercostal muscles, by causing caries of the ribs, sternum, or spine, extensive fistulous abscesses in the walls of the chest and abdomen, or tuberculous deposits in the lungs, and at the same time injuring the constitution generally, it leaves the body in a condition most unfavourable to the restoration of health. These circumstances suggest the propriety of anticipating the process of nature, by artificially evacuating the matter before these serious consequences ensue.

Treatment. The leading indications in the treatment of pleurisy are, 1. To subdue the inflammation; 2. To promote the removal of its more injurious product; 3. In chronic cases to improve the state of the general health, and to counteract the injurious effects of the persisting disease.

The most desirable object is to destroy the inflammation at its very onset, before the signs show that the effusion is considerable. For this purpose, the most effectual remedy in severe cases is a full general bleeding, carried, if possible, to such an amount as to remove all pain on full inspiration; or, if there be little or no pain, until all hardness of the pulse ceases. This should be followed by free leeching or cupping of the affected side. We think leeches generally preferable; but they should not be applied sparingly, and they should be immediately followed by a large warm poultice covered with flannel, or by a succession of warm dry napkins. These depletory measures must be repeated if within a few hours the pain return, or the pulse resume its hardness. Of internal remedies, those are the most useful, in the first instance, which assist the blood-letting in producing an impression on the circulation, especially brisk purgatives containing mercury and antimony, which act fully on all the secretions. Calomel and James's powder, followed by an active draught consisting of salts and senna, generally answer best. Tartarized antimony is less effectual in this than in other inflammations of the chest; it may do harm if it excite vomiting; but in doses short of that effect it may prove useful.

It commonly happens that such measures take off the edge of the disease without destroying it entirely, or, at least, without removing its products, which must be a work of time; and although the pain, dyspnea, and cough be much relieved, they are not removed, and the physical signs show that the effusion has taken place to a greater or less extent. Under these circumstances the proper means are those which promise to fulfil both indications, to reduce the remaining inflammation, and to promote the absorption of the matter already effused. The most powerful of these is mercury, which may be combined with ipecacuanha and opium, to lull the pain and to prevent the calomel from passing off too freely by the bowels. These remedies should be given in pills every three or four hours; and to them may be added digitalis or colchicum in a saline mixture, with an excess of alkali, to keep down the action of the heart and arteries, to determine to

the kidneys and skin, and to lower the inflammatory condition of the blood. The beneficial influence of mercury is sometimes apparent when it does not affect the gums, especially in young subjects; its operation being only manifest on the hepatic and alvine secretion, which is green, dark, or high-coloured, from different conditions of the bilious matter in it: but in most cases the gums exhibit the effect of mercury before these secretions are produced.

Venesection can seldom be repeated with much advantage after the first few days, unless on the occasion of a fresh access of pain, or other symptoms which denote the renewal of acute inflammation. Occasional leechings continue to be useful; but after the inflammatory fever has been reduced, the most effectual external remedies are blisters, which should be used large, and not left on too long; from six to eight hours is generally time enough to make them vesicate without inflaming the tissues too deeply, or irritating the system by the absorption of their serous discharge. Where the effusion is abundant, a succession of blisters will be necessary; or they may be varied by a suppurating counter-irritant, such as the tartar-emetic ointment or solution.

The diet must be of the most spare kind in the early stage of acute pleurisy; and the patient should remain as quiet as possible in bed. But when the inflammation is subdued, sitting up, and, if the strength will permit it, using a little exercise about the room, will be beneficial in promoting the absorption of the fluid.

In limited varieties of pleurisy, such as those of a mild or partial kind, those excited by tubercles, and in those which occur in combination with typhoid or asthenic symptoms, the antiphlogistic measures above described must be reduced to suit the nature of the case, and the amount of the general strength. Circumscribed pleurisies may sometimes be removed by cupping or leeching only; and in conditions of the system depressed by febrile or other morbid poisons, or reduced as in phthisis, blisters, or sinapisms may be the only antiphlogistic means which can be borne. In continued fever, besides these external means and the usual salines, mercury in combination with opium is, according to our experience, the most appropriate remedy.

If, in severe cases, from insufficiency or delay of treatment, or in spite of it, the signs of effusion continue beyond two or three weeks, little or not at all diminished, with more or less constitutional disturbance, it is to be apprehended that the disease will take a chronic form, in which the character of the treatment must be to a certain extent changed. If the strength continue to diminish, the pulse be weak, and the fever (if present) of a remittent or hectic kind, a more nutritious and tonic plan must be cautiously pursued to the extent that the patient can bear; the heat of skin, pulse, cough, and condition of the breathing being referred to as tests of the suitableness of the change. But external counter-irritation should still be continued, especially by blisters, which may perhaps be useful not only in reducing internal inflammation and in promoting the removal of the effusion, but also, as Dr. Stokes supposes, in restoring energy to the inactive external muscles of respiration, as they sometimes do to the muscles of a paralyzed limb. The secretions must be kept free by medicines of a milder class than those used in the acute stage; and, except with this object, we have not found much benefit from mercury in the advanced asthenic stages of simple pleurisy. In fact, when the effusion is purulent, the constitutional effect of mercury seems to be injurious. In these stages we have seen the most salutary effects result from the employment of the hydriodate of potass, which seem to act both as an alterative and as a diuretic. Dr. Stokes highly recommends iodine, both internally and externally, in the form of a pint of Lugol's mineral water daily, and from a quarter to half an ounce of the ointment rubbed into the side. We prefer the hydriodate simply, in the dose of two or three grains, three or four times a-day; and in the more asthenic cases, the iodide of iron in rather smaller doses. As there is apt to be in both these medicines some free iodine, which we believe to be the chief cause of the unpleasant symptoms which they are sometimes said to produce, it is well to direct the patient to eat a bit of bread or biscuit after each dose; the starch of this, combining with the

free iodine, removes its injurious property; and with this simple precaution we have administered both these remedies in numerous instances, for a great length of time, without ever inducing the gastric irritation and nervous symptoms which are commonly ascribed to iodine, and which we have seen produced even by Lugol's diluted solution. These medicines seem especially calculated to promote absorption; and, combined with blisters, we have found none so efficacious in hastening the removal of a pleuritic effusion.

Various other medicines are occasionally useful. As diuretics, Laennec recommended acetate and nitrate of potash in very large doses, such as from 3ss to 3ij of the former, and 3ss to 3iv of the latter, occasionally combining with them hydrochlorate of ammonia and squills. Where a dropsical diathesis prevails we have occasionally found the tartrate of iron a good diuretic. But in some such cases, a coagulable state of the urine sometimes indicates a state of the kidneys in which diuretics prove injurious. Under such circumstances, powerful purgatives and diaphoretics alternated are sometimes useful in reducing the effusion. But such remedies can seldom be used for any length of time without causing serious weakness and disorder, and are, we apprehend, more hazardous than the simple operation of mechanically drawing off the fluid.

Gentle exercise and friction are commonly serviceable in promoting the expansion of the chest and lungs, and the absorption of the fluid. In the more chronic cases, it is of the utmost importance to promote the general health by free exposure to a pure, mild, and suitable air; and in cases disposed to scrofula, this will be best found at the sea-side.

The removal of the fluid effused by pleurisy through an artificial opening in the chest (*paracentesis thoracis*,) the utility of this operation, and its mode of performance, have long been, and are still, subjects of much question among both medical and surgical writers. We must refer to other works for the different opinions on these points: we shall endeavour to state in the simplest terms the general results of our reading, observation, and reflection on the subject.

There are two kinds of cases in which it becomes proper to give exit to the liquid accumulated in the pleural sac. One includes the examples of the recent disease, in which the effusion takes place so quickly and abundantly as to endanger life by the pressure which it causes on the lungs and blood-vessels. A sudden effusion may have this effect, where its quantity is not sufficient to compress the lung totally, or to displace the viscera to a great extent, especially if the lungs be previously disabled, as by emphysema, catarrh, &c.; there is, however, always some enlargement of the side, which, with dulness and absence of respiration and vocal vibration, will sufficiently indicate the nature of the case. Here the liquid is generally serum, with more or less lymph, and it commonly deposits a farther clot of gelatinous fibrin after it has been drawn from the chest: the same liquid is however sometimes yielded by pleurisies of long standing. The other class comprehends those cases in which the pleurisy has existed for a long time; and the effusion instead of showing a disposition to disperse under the influence of remedies, either increases or remains stationary; and whether it cause a dangerous degree of dyspnoea or not, its longer continuance must do mischief by perpetuating the compressed state of the lung, as well as by the various other structural and functional affections which we have before alluded to. The cases of true empyema are generally included in this number, and are considered the more legitimate subjects for operation, because there is less chance of purulent matter being removed by absorption; but we must add that the operation has not been so often successful in these cases as where the effusion is not purulent.

Now the object of the operation is to remove the fluid, which either from its quantity oppresses the functions, or by its quality extends and perpetuates the structural lesions of the chest and its organs. With this view, an outlet is given to it, any number of times, until its quantity is so far diminished and its quality improved, that it shall not prevent the re-expansion of the lung as far as that is possible; the contraction of the chest filling up the deficiency as the remaining

fluid is afterwards gradually absorbed. It is easy to perceive that after the distention is relieved by the flow through the opening, the remaining fluid cannot be drawn out of the chest without something to occupy its place; and, unless proper precautions be taken, that something will be air, drawn by inspiration, not into the lung, but through the orifice into the cavity of the chest. Air thus introduced often seems to have the effect of causing an unfavourable change in the nature of the remaining liquid, rendering that which was serous decidedly purulent, and giving to pus a fetid character. Farther, when air gets access, it tends to do mischief, whether the orifice remain open or be closed: in the former case, the air passing in and out prevents the lung from expanding, and constantly irritates the serous membrane, which is not fitted for contact with it; and if it be closed, the air admitted tends to engender more air by the decomposition which it causes in the remaining fluid, so that the pleura soon becomes as much distended as before the operation. Hence, although the operation generally gives temporary relief, it has often been followed by symptoms of irritation, or of increased oppression, which have ultimately led to a fatal result. It is true that in some cases the cause of failure is irremediable disease in the walls or viscera of the chest, or perhaps in the constitution, which may be either the cause or the effect of a long continuance of the pleuritic effusion; but even in these cases, the operation may prove the means, either of great temporary relief, and considerable prolongation of life, or of just the contrary, according as it is, or is not, performed with due reference to sound physiological and pathological principles. The operation has, we admit, sometimes succeeded where these principles do not appear to have been much attended to; but this has been for the most part in young subjects, where the reparatory powers are active, and sufficient to countervail very unfavourable circumstances; and we are confident that it would succeed in many more instances, were it resorted to at the time in the way pointed out by our improved knowledge of the subject. One great error has been to delay the operation too long, until some of the bad consequences of the disease, such as obliteration of the tissue of the lung or deposits in it, surfaces secreting inorganizable matter, and incapable of adhesion, ulceration and even sloughing of the soft parts, caries of the bones, morbid deposits in other parts, and depression of the vital powers generally, prevent the possibility of recovery. Another great error we consider to have been in the neglect of all means to promote the re-expansion of the lung, which is the only natural mode of supplying the place of the fluid drawn off, and is an obvious step towards a restoration of the healthy condition of the parts.

The operation of paracentesis thoracis has been in use since the time of Hippocrates, and has been held in different degrees of estimation by the very numerous authors who have described it in its various modifications, but a great preponderance of opinion is in favour of its utility and safety when properly performed. It is very remarkable that many of the more important precautions in the operation were attended to by Hippocrates and his followers more than by the greater number of writers down to the present century; and we find from the "aphorisms," that the operation was considered to be the only means of cure, and when these precautions were attended to, and the fluid white and of good quality, the patients recovered. The chief of these precautions were, not to delay the operation after the existence of the empyema is known, and to draw off the liquid gradually, at successive periods, closing the wound in the interval. We must refer to works on surgery for details of the different modes of operating; and we would remark that from the time of Hippocrates to that of Laennec, although many new plans were proposed, little improvement had been made, and the credit of the operation had rather declined than otherwise; but the greater precision conferred by the latter author on the diagnosis and pathology of effusions in the chest, has furnished the means of rendering this operation more successful than it has hitherto been. Formerly the signs of the very existence of empyema and hydrothorax were so uncertain, that many patients have been tapped when there was no effusion: in many, the existence of empyema was not suspected

until it had proved fatal, or produced changes which prevented recovery; and in many instances the almost hopeless lesion of tuberculous perforation of the lung and pneumothorax has been joined with liquid effusion, and its incurable character has thrown additional discredit on the operation. But now we have sure means not only of detecting the presence of liquid in the chest, but in a great measure also of discovering the complicated lesions, and of distinguishing the cases which give the operation the best chance of success. The same means also enable us to simplify the operation; for, whereas, formerly it was expedient to make a long incision with a knife or lancet through the integuments, and then cautiously to divide the intercostal muscles and pleura with a bistoury, for fear of wounding the lungs or heart, now the surgeon, guided by the physical signs and the exploring needle, may without fear plunge a trocar at once into the chest, thus much diminishing the pain of the operation, and the risk of hæmorrhage.

Before describing the mode of operation which we would recommend, it is necessary to advert to some disputed points in regard to it. One respects the place for making the puncture. In case of the matter forming an abscess in the walls of the chest, there is no choice: this must be opened; but in the absence of such pointing, it is of importance to determine what is called the *place of election*. The majority of the older surgeons preferred the inferior parts of the chest, under the notion that the fluid would ponderate there. But as the fluid occupies the whole pleural sac, and by change of posture may be made to ponderate in any direction, this notion is of no weight in opposition to the risk of wounding the diaphragm and abdominal viscera in these regions. Accidents of this kind have repeatedly occurred. Laennec gives an instance in which a trocar passed between the fifth and sixth ribs on the right side, perforated the diaphragm and entered the abdomen; the diaphragm having been pushed up by an enlarged liver. In other cases, the liver, the kidney, and the lung have been wounded, the latter in consequence of its adhering to the diaphragm. On the other hand, the objection against puncturing the upper parts of the chest is chiefly on account of the greater frequency of adhesions of the lung there. The middle portions of the chest are therefore generally considered the most eligible, between the third and seventh ribs: and as the intercostal spaces are widest, and there is less thickness of the walls at the side, this part is generally selected as the place of puncture. Another debated point is, whether as much of the liquid as possible shall be evacuated at once, the aperture left open, and a canula inserted, or a little only at a time and the orifice closed. In regard to the quantity to be drawn off, we are fully persuaded, by the study of recorded cases, and by personal observation, as well as by reflection on the pathology of the case, that the Hippocratic method of evacuating the fluid *gradually at successive times, closing the orifice in the intervals*, is the best; both because it give the lungs time to expand, and the vessels to adapt themselves to the diminished pressure, and also because it affords the best means of preventing the admission of air through the orifice. For the same reasons we decidedly disapprove of the practice of leaving the orifice open, and particularly of leaving a canula in it. In proportion as the air has free access to the pleural sac, it will irritate it, perpetuate its inflammation, and prevent the lung from expanding, even in cases where it does not cause decomposition of the remaining fluid. But in many instances the fœtor, which in the course of two or three days is perceived in the air and discharge which proceed from the orifice, becomes evidence of the latter mischievous effect of the introduction of air; and not a few patients have obviously sunk under the pernicious influence of the putrid matter thus generated. This result has ensued in some cases even where air has been admitted only in a very small quantity; and we therefore hold it to be highly desirable to prevent the entrance of any air. We are surprised that Dr. Townsend, who otherwise advocates the plan of the gradual discharge of the fluid, and the closure of the orifice, expresses a doubt whether the admission of air be really hurtful, and supports the doubt by the experiments of Nysten and Speiss, who found that air introduced into the healthy pleura was invariably removed by absorption in the course of a few

days. These are obviously not parallel cases, and it is highly improbable that air admitted to a serous cavity whose absorbing properties are manifestly impaired, the membrane being covered with products highly disposed to decomposition, will be absorbed without farther mischief. To prevent the admission of air, it has been lately proposed to puncture the chest under water, the patient being in a warm bath; and this expedient is well worthy of attention, particularly in cases where, from the long continuance of the disease, and consequent loss of expansibility of the lung, and elasticity of the walls of the chest, the method to be described afterwards may be insufficient. Several writers have recommended liquid injections with the view both to expel the air and to facilitate the discharge of the matter. The ancients in some cases injected oil and wine to promote the healing of the cavity; and it has repeatedly been tried, and sometimes with good results, to attain this by aromatic and tonic vegetable infusions. Sir P. Crampton used with success an injection of a weak solution of chloride of lime. However useful these injections may be for these purposes, they must in some degree prevent, rather than favour, the re-expansion of the lung. To attain this point, as well as to increase the discharge of the liquid, it has been attempted to suck the latter through the orifice, by means of different kinds of syringes. Laennec proposed using a cupping-glass with an exhausting syringe after the puncture: this contrivance would probably draw off the fluid and promote the expansion of the lung very effectually; but unless the operation be conducted with great care and gentleness, there may be danger of rupturing the lung by the forcible entry of the air into it, or it would be almost impossible in the mode proposed by Laennec to prevent air from entering through the puncture on removal of the cupping-glass. Still we think that the expedient might be useful and safe by means of a little management, by which the canula should be slipped out, and the integuments drawn over the puncture, so as to make it valvular before the cupping-glass is removed, when the orifice might be farther secured by means of a compress confined by strips of adhesive plaster.

But we apprehend that the exclusion of air as well as the expansion of the lung, as far as that can be safely attempted, may be effected by applying manual pressure to the walls containing the effusion, and by closing the orifice before that pressure is removed. The following is the manner in which we recommend the operation generally to be conducted.

The spot for the introduction of the trocar must be determined with due reference to the physical signs; carefully avoiding every part where or near which there is sound of respiration, voice, or not perfect dulness on percussion. A projection and fluctuation of an intercostal space give greater eligibility to a spot; and these circumstances present themselves most frequently at the inferior lateral parts of the chest from the third to the seventh rib, where also the soft walls of the chest are as thin as any where. In all cases it is a proper precaution to pass a grooved needle first, as recommended by the late Dr. Thomas Davies; for this at once determines the presence of the liquid, its quality, and the thickness of the walls which contain it at that spot. Of course it is proper to avoid the immediate vicinity of the heart or of any of the known arteries or nerves. The upper margin of the fifth or sixth rib most commonly presents a favourable spot, but whether more or less at the side must be determined by the position of the heart and other circumstances. The patient should be lying on his back, inclining to the affected side, and not more raised than is necessary for the state of his breathing. The skin should be drawn aside, so that the puncture through it may not, after the trocar is withdrawn, correspond with that of the costal pleura, but form a valvular orifice. The trocar should not be pushed in farther than is necessary to clear the parietes; but the canula may be pushed in farther after the stilette is withdrawn, and its sides should have several holes in them. As soon as the stilette is withdrawn, steady pressure should be applied by a bandage or by the hands of assistants, to depress the shoulder and ribs, and to push up the diaphragm on the affected side, to promote the flow of liquid and to prevent the introduction of air through the orifice during any sudden or forcible act of inspira-

tion. For the same reason, during a fit of coughing, if there appear any tendency to intermission in the stream of liquid, the orifice should be closed by the finger. The pressure should be steadily increased as the liquid flows; and if the stream should stop, a probe may be passed through the canula to clear it of clots of lymph or any other obstructing matter; but if still no more flows, a compress, or if the liquid is purulent, a large poultice should be placed on the orifice; and then, but not till then, the pressure on the walls of the chest may be discontinued. The result will be, that the walls of the chest, expanding by their own elasticity on the removal of the pressure, will draw air into the compressed lung, which, being thus inflated, will begin to resume its part in the function of respiration and circulation, and will thus promote the absorption of the rest of the fluid, and improve the condition of the whole system. Even if the fluid should accumulate again, the temporary expansion of the lung will have served to restore its natural properties, so that when another quantity of fluid is again withdrawn its tissue will be better prepared for a restoration of its function.

Performed in the manner as directed the operation is almost free from risk, and will seldom fail to give relief. If the liquid be purulent it will generally be necessary to repeat the operation several times; but if it be serous, one tapping, which will partially expand the lung, will often be sufficient to give a turn to the disease, its complete removal being effected by nature aided by appropriate remedies.

When the fluid is purulent, we should strongly recommend the injection of warm water with the view to displace it; but instead of doing this, as it is usually practised, with a single tube, it should be done through a double-tubed canula, the tube for injection being cautiously carried two or three inches into the chest, whilst the evacuating tube is merely long enough to pass through the walls. If warm water previously boiled be then thrown in through the long tube by Read's syringe, it will drive the matter through the short tube; and in this way the greater bulk of the secretion will be displaced by water, which is very likely to be absorbed. If after repeated evacuations there be no apparent disposition to the expansion of the lung or contraction of the chest, and matter continues to be secreted, it may be useful to use medicated injection, such as a very weak solution of nitrate of silver, or chloride of soda. The pleural sac may be treated as an abscess, and if the discharge be unhealthy it is quite proper to correct it and to promote the healing of the diseased parts by such means as are known to promote granulation and desiccation of suppurating wounds. When the discharge is fetid, it is more decidedly necessary to correct it by injections of chlorinated solutions, mixtures of creasote, or other antiseptic liquids. The same practice may be advantageously pursued when the matter has pointed and open spontaneously, leaving a fistula which may remain open for months and even years. Dr. Townsend mentions the remarkable case of Dr. Wendelstadt, who had been tapped thirteen years before, since which time the wound had remained open and discharged daily to an amount varying from half a drachm to four ounces. The diseased side was much contracted, and did not move in breathing, yet he could blow the flute, walk fast, and actively perform his professional duties.

Pleurisy when free from complications is not of much danger except in those cases in which a very large purulent effusion or empyema takes place; in this case, as the absorption is difficult, death not unfrequently ensues from the continued irritation and dyspnœa. But pleurisy, although in itself of little comparative importance, becomes a very serious affection from its connexion with tuberculous diseases of the lungs and of the membrane itself. In some cases it is a cause of the tuberculous disorder, in others, a mere sign of its presence. We regard the pleuritic inflammation as the cause of tubercles, when it occurs in a person who was previously in good health or nearly so, and is followed immediately by pulmonary phthisis, or when the symptoms of the pleurisy are gradually replaced by those of the tuberculous disease. In these cases the pleurisy acts as a cause in two ways: 1st, by the long continued irritation, which at last favours the development of tubercles either in the lung or pleura

and 2d, by a peculiar modification of inflammation giving rise, in the first instance, simultaneously with the ordinary products of inflamed serous membranes, to a tuberculous secretion. In both cases there is probably a tuberculous predisposition, or cachexia; but the individual is often robust and in apparent good health, and the evidence of a tuberculous disease is rather a matter of inference than of positive demonstration. In many instances it is probable that there was no previous predisposition, but that some peculiarity in the mode of invasion of the disorder, or of local circumstances in which the patient was placed, caused the tubercles to be developed in this sudden way.

When the tuberculous disease has been gradually forming before the pleurisy, the serous inflammation is a mere consequence, and has little influence upon the course of the disorder. It is, therefore, of little interest to the physician except as a sign of the tuberculous disorder; for as we shall afterwards see, repeated attacks of pleurisy, if combined with some of the general symptoms of the tuberculous affection, are very good indications of pulmonary phthisis. The same rule holds good in a still stronger degree if the pleurisy first attacks one side and then rapidly passes to the other.

The signs of pleurisy connected with a tuberculous disease differ but little from those of the same inflammation when it is perfectly uncomplicated. The physical condition is the same, and the signs which depend upon it are, of course, perfectly similar. The diagnosis of the tuberculous variety, or of the pleurisy which is about to pass into phthisis, depends upon the symptoms of constitutional irritation. If these are permanent, the disorder is apt to terminate in phthisis; that is, there are at the time tubercles in the lungs or pleuræ which may probably become more completely developed, and general phthisis will then follow. In many cases the tuberculous disease seems to abate, and the inflammation of the pleura passes through its stages and presents towards its close the symptoms of tuberculous deposit. But the morbid secretion is not abundant enough to pass into phthisis, which is nothing but a more advanced stage of the disease. The fever of empyema, and even of the early stages of simple pleurisy, resembles very closely, it is true, that of incipient tubercular disease, which signs show that the constitutional irritation is in both cases nearly the same, and is often accompanied with the double secretion of lymph and tuberculous matter.

The practical importance of attending to the relation between pleurisy and phthisis is sufficiently obvious. The pleurisy should be watched after the decline of the urgent symptoms, and the patient should not be neglected until conducted to a full convalescence. The remains of the inflammation may be most effectually removed by the repeated application of small blisters to different parts of the chest, not larger than two or three inches square. These create but little irritation, but at the same time are sufficiently powerful in their action. The mercurials and nauseants, with other debilitating remedies, which act so well in the early stages of pleurisy, are not applicable to those cases in which, with a declining strength, symptoms of tuberculous disease begin to manifest themselves; we are often in such cases obliged to combine with the local counter-irritation a tonic treatment by the wild-cherry bark, and sometimes the addition of the preparations of iron, or of iodine according to the case. The mercurials and other antiphlogistic remedies, are not adapted to those cases in which phthisis has positively declared itself, but they are often the surest means of preventing it by quickly curing the inflammation, and thus relieving the disease before tubercles are formed. After the acute inflammation is entirely removed, a sea-voyage or a journey is often of great benefit, and may complete the cure.

As to the propriety of performing the operation of paracentesis, my own views accord entirely with those of the author. The operation is followed by more or less relief of the dyspnoea, but the admission of air into the cavity of the thorax generally increases so much the irritative fever, by the decomposition of the purulent liquid, that the result is almost necessarily fatal. I never advise the operation, therefore, except as a last resource, when other means have failed, and when the pus is evidently tending towards the exterior. The precautions advised in the text should always be kept in mind.

G.

PNEUMOTHORAX.

Modes in which it may arise.—Physical signs.—Prognosis.—Treatment.

PNEUMOTHORAX (from *πνευμα*, air, and, *δραξ* the chest) implies the presence of air in the cavity of the chest. The discovery of this disease, or rather of this effect of other pulmonary lesions, is of modern date, though it for a long time received no distinctive name till the term pneumothorax was proposed by M. Itard, and subsequently adopted by writers on pulmonary diseases.

Pneumothorax may be produced in three different ways:—1. It may be the consequence of a partial pleurisy. We have mentioned, that after a pleuritic effusion has long compressed the lung, and the compression has been perpetuated by a rigid false membrane formed over it, the absorption of the liquid leaves a void, which the collapse or contraction of the walls of the chest is in some cases insufficient to obliterate, and this void is sometimes filled with air secreted by the membranes. We have seen two instances of partial pneumothorax produced in this way. They each occupied about half of the pleural sac; in one case the upper, in the other the lower half; and the lung in both cases was strongly bound down by fibro-cartilaginous membrane, and condensed in the part contiguous to the empty space. There was also some contraction of the chest in both cases. This kind of pneumothorax is very rare.

2. Another kind of pneumothorax is that which may be called idiopathic, and arises from an effusion or secretion of air into the sac of the pleura without perforation. This is also of very rare occurrence. It is said to occur sometimes towards the termination of fatal diseases, in the same manner as tympanitis occasionally occupies the peritoneal sac under similar circumstances. We have never met with such a case in which the signs of pneumothorax were observed during life; but we have several times seen a little air in the pleural sac when it is opened after death, without any discoverable perforation of the pleura. It is possible that a little air may have been exhaled from the animal fluids after death, and then increased by exosmosis through the lung: the facility with which gases pervade dead membranes countenances such a notion. Pneumothorax is also said by Drs. Hudson, Graves, and others, to have occurred in a few instances at the commencement of pneumonia, and to have soon afterwards disappeared: but as the chief sign in these cases was a remarkable resonance on percussion, we suspect that these were examples of the production of tracheal or amphoric sound, from consolidation of the upper lobe of the lung, and not cases of pneumothorax.

3. By far the most common kind of pneumothorax is that caused by some unnatural communication between the pleural sac and the external air, and this may be by a perforation either of the external parietes or of the pulmonary pleura. The latter case is now recognised as the usual cause of pneumothorax, and constitutes the great bulk of the examples that are met with. The perforation depends on the progress of the ulceration, generally of tuberculous character, rarely of gangrenous abscess, through the pleura. The circumstance of ulceration reaching and perforating the pleura indicates a low state of the reparative powers, and a want of plasticity in the products of inflammation; for under ordinary circumstances ulceration could not approach the pleura without causing it to inflame and throw out coagulable lymph, which, becoming organized, forms either a protecting thickness of membrane, or close adhesions to the costal pleura. We see this in most cases of chronic phthisis, where the upper lobes are generally adherent to the ribs. We have seen ulceration extend from a tuberculous cavern across the two layers of the pleura, thickened and adherent, and completely through the walls of the chest, so that when the patient coughed, air bubbled out of two or three fistulous openings in the front of the chest, but there was no pneumothorax. On the other hand, we have met with more than one case in which

the adhesive process seemed quite incapable of protecting the pleura, which was consequently perforated at several points, wherever in fact the ulceration of the lung reached it, and air freely passed into the pleural sac by all these holes. More commonly however, there is only one perforation; and this is generally near the apex of the lung, in connexion with some of the cavities which first form there.

The completion of the perforation is in most instances sudden—a part thinned by ulceration, and imperfectly adherent, giving way during a fit of coughing, or some other unusually forcible act of respiration. We have met with an instance in which external violence produced the rupture. The immediate effect of the perforation is to admit air more or less rapidly into the pleural sac, which by equalizing the atmospheric pressure outside and inside of the lung, permits it to assume that state of collapse to which its natural elastic contractility would reduce it. Hence dyspnœa, sudden and severe in proportion to the extent to which the air enters and the lung becomes collapsed. But the access of air to a serous membrane totally unaccustomed to it, with perhaps the discharge of matter from the ulcerous opening, also occasions great irritation and consequent inflammation of the pleura. Hence a sudden sharp pain and dry cough, with spasms of the intercostal muscles and a weak quick and sometimes irregular pulse. Soon the irritation becomes accompanied with inflammatory reaction, and then follow the symptoms of acute pleurisy with heat of skin and inflammatory pulse; and liquid effusion is added to the air in the pleural sac.

Although a perforation of the pleura will not fail to introduce air into its sac, the amount and effect of this introduction of air will vary considerably according to the size and other conditions of the ulcerated opening. If this be very small, or if, as it not unfrequently happens, it be so placed that the walls of the chest close it in expiration, by which it is rendered valvular, or if it be below the level of the liquid, the air introduced by each inspiration will not escape as freely in expiration, and the result will be the progressive accumulation of air in the pleura, and a consequently increasing compression of the lung and dyspnœa; and in this way perforation of the lung has in some cases caused suffocation within a few hours of its occurrence; in others this catastrophe has been delayed by the egress of the air by accidental changes of position, by violent coughing, or by puncturing the chest. If the aperture be of larger size, and no impediment occur to the passage of air through it, it will interfere with respiration only so far as it suffers air to pass outside of, instead of into, the lung. But when the air passes thus freely, the pleura is more irritated by it, and there is a more copious secretion of liquid, which is generally more or less purulent and often fetid. In either of these cases, after the subsidence of the spasm, pain, and dyspnœa, first caused by the entry of the atmospheric air, there are no characteristic general symptoms which can serve to distinguish pneumothorax. The occurrence of perforation may sometimes be suspected from the sudden supervention of acute pain of the side and oppression, which the patient in some instances refers to something having given way during a fit of coughing. But such sudden attacks sometimes take place from pleurisy without perforation, and we have repeatedly known perforation happen without being followed by any remarkable increase of pain or distress.

The *physical signs* of pneumothorax are generally very remarkable and distinctive. The presence of air in the pleura will give to the walls of the chest a freedom of vibration, and therefore a degree of resonance on percussion, even greater than that which the air-filled structure of the lung confers upon them; so that percussion will give more of the drum-like note or tone which is obtained by striking on the region of the stomach or cæcum. This is more marked in proportion as the quantity of air is considerable. The same circumstance will also impair or destroy the sound of respiration; for the air not only removes to a greater distance the pulmonary structure in which this sound is produced, but also by its pressure diminishes that entrance of air into the cells on which the sound depends. There will be therefore this remarkable contrast of signs to distinguish pneumothorax—a clear or hollow sound on percussion, with little or no

sound of vesicular respiration, whilst the healthy side gives a duller sound on percussion, but a much more distinct respiratory murmur.

There is however produced in air-filled cavities another class of sounds, which often gives decisive evidence of their existence. The character and cause of these sounds may be shown by a simple experiment. If the mouth of a caoutchouc bottle be held to the ear, and its outside struck, each stroke causes a short tinkling note, like the clink of a piece of metal or glass. This note is a kind of echo, produced by the reverberations or repeated reflections of the impulse from the walls of the cavity, and it is shrill and acute because the reflections are short and quick in so small a space. The same kind of note may be heard in other hollow bodies, such as an empty cask; but it is there less shrill, because the space is larger. Any sound proceeding from, or communicated to, the interior of the cask, the caoutchouc bottle, or any cavity in the body with reflective walls, will be accompanied or followed by this sort of tinkling or ringing echo, which will be more prolonged and distinct in proportion as the walls are perfectly and uniformly reflecting. Sounds of this kind may often be heard on using the stethoscope over the stomach and large intestines, as their contents move and cause a sound within them. So, too, this tinkling echo may accompany the sounds proceeding from an air-filled cavity in the chest, and it becomes a distinctive sign of the existence of such a cavity.

In idiopathic pneumothorax, and in that partial kind resulting from the absorption of a pleuritic effusion confined by adhesions, although the cavity be present, there may be no sound produced in it, or transmitted to it, so as to cause the tinkling echo. Sometimes percussion on the external walls will do this; and we have heard the metallic tinkling accompany both the voice and the cough in a case of partial pneumothorax without liquid effusion or perforation of the pleura, the sound being transmitted to the cavity through the condensed tissue of the lung. But it is where the pleura is perforated and where liquid is present, that the phenomenon of metallic tinkling is commonly heard; not, as Laennec supposed, because these conditions are essential to its production, but because the motions of the liquid or of the air through the orifice make sounds within the cavity which serve to show its echoing properties. So metallic tinkling has often been heard after the operation for empyema, manifesting the presence of air in the pleura.

Perforation of the pleura, with its consequence, pneumothorax and liquid effusion, is not a very uncommon accident in the course of phthisis; and its signs are so remarkable, that they can scarcely fail to be recognised even by those who are but moderately versed in auscultation. The tinkling echo may present several modifications, which it is useful to notice, as they serve to give a more accurate knowledge of the condition of the parts and of their tendencies. When the perforation is small, or obstructed by its position against the walls of the chest or below the level of the liquid, the tinkling is seldom heard except on coughing or taking a full breath, which reaches the cavity and may throw the liquid into bubbles. The voice may also sometimes reach the cavity through a consolidated portion of the lung, and then it will be accompanied by a tinkling. When the orifice is large and free, the air will pass in and out in ordinary breathing, and will produce in its vicinity a sound like that of blowing into the mouth of a glass bottle: this kind of respiration is therefore called *amphoric*. In such cases there is seldom so much oppression of the breathing as in those where the air passes less freely and accumulates in the cavity. In listening for the tinkling phenomena, it must be held in mind that they may be audible only in certain parts of the chest where the lung is not adherent, and where the liquid effusion does not reach. Generally, in the sitting posture they are heard best about the *mammæ* and the lower part of the scapula and axilla; but we have heard them in some cases in every part of the affected side, and in others only in one spot. In fact, there must be a certain degree of tension in the walls of the cavity to make them good reflecting surfaces, and if this be deficient at the spot of the cavity opposite to

that on which the stethoscope is applied, the sound may be absorbed and not reflected.

The addition of the liquid to the air in the chest makes the diagnosis still more easy. By percussion we can find the exact level to which the liquid rises, and that this level moves with change of posture; this is much more distinctly perceptible than with simple liquid effusion. The motions of the liquid may farther give very decisive evidence of its presence with air in the cavity. On change of posture and on coughing, the liquid will sometimes drop from the parts which have just been immersed; and the sound of this will exhibit the metallic ringing in so distinct a manner, that it resembles the note which a glass or porcelain vessel yields when struck. If the liquid be agitated more forcibly, as by the patient giving his trunk an abrupt jerking turn, or being violently shaken, it may be heard to splash most distinctly against the walls of the chest: this is the sign of *succussion* described by Hippocrates. It may be best heard by applying the ear to the chest at the time of the movement, and then the tinkling is heard to accompany it, and sometimes to follow it as the liquid drops from the sides, or the bubbles break on its surface. The splashing is not easily produced, unless there be a good deal of air in the pleural cavity with a moderate quantity of liquid. The proportions of these are however better ascertained by percussion.

The *prognosis* of pneumothorax from perforation must be generally unfavourable, because, besides its own formidable character, in the vast majority of cases it arises from tuberculous disease of the lungs. Provided however the tuberculous disease be very limited, it does not seem unreasonable to think with Laennec that the case may not be entirely hopeless. Laennec mentions an instance in which pneumothorax lasted for six years. Dr. Houghton describes another in which the individual survived the perforation eighteen months, and probably would have lived longer if he had not imprudently exposed himself in his work as a bricklayer; for the signs of the cavity had disappeared, the side had contracted, and the general health had been much improved. In a case related by Dr. Stokes, the patient lived for many months, during which he rode much on horseback, and could hear a splashing in his chest when he trotted or cantered. We have known two patients with pneumothorax leave the hospital with the impression that they were nearly well, having gained flesh, and lost the worst phthisical symptoms after the first severe consequences of the perforation had subsided. In such cases which are to be considered exceptions to the general rule the production of the new disease in the pleura seems to act favourably in retarding the tuberculous affection of the lung; and if this be of limited extent, it is possible that it may be removed, the wound on the lung cicatrised, and the cavity of the pleura obliterated by contraction and adhesion.

I have seen a case in which the patient lived for a year and made two long voyages, doing full duty as a seaman, going aloft, &c., yet the purulent effusion continued in his chest. On his return to the hospital about one year after his discharge, the gas had wholly disappeared, and the whole pleura was enormously distended with a purulent liquid, which was on the point of perforating the walls of the chest. It was not judged advisable in the circumstances of the patient to perform the operation for empyema. In another case, the patient, a stout mulatto, lived a still longer period, about eighteen or twenty months; he returned to the hospital after he had left it, and remained in the enjoyment of tolerable health, although too short-breathed to be capable of any laborious occupation. This case at last proved fatal.

In neither of these cases did the tuberculous disease apparently advance: a few scattered tubercles only were found in the lungs, and the consumption had scarcely formed itself when a single tubercle softened near the pleura, and gave rise to the pneumothorax.

In another case which I witnessed, death took place in less than half an hour. The lung which was perforated contained but few tubercles, but the other lung was filled with them and offered numerous cavities at its summit. The respiration therefore was cut off, as the only lung which was capable of performing this act was suddenly rendered unfit for its function.

On examination after death the injection of the pleura had already commenced, and there was a very slight deposit of lymph around the perforation.

I am not, however, sure that I have seen any case of absolute recovery.

G.

Treatment. The measures calculated to relieve the symptoms of pneumothorax with perforation vary considerably according to the period of the lesion, and the condition of the system. In the first instance the perforation and access of air and matter to the pleural sac is often attended by considerable prostration of the system with rapid feeble pulse and faintness, together with the pain and cough, which are then the result of irritation rather than inflammation. Considerable doses of opium or morphia are necessary to allay this irritation; they may be advantageously combined with calomel and antimonials; and sinapisms or warm fomentations may be applied to the affected side. More active antiphlogistic measures cannot be used until the reaction takes place, which generally begins in a few hours, bringing with it heat of the skin, strength and hardness of the pulse, and great soreness as well as pain of the whole affected side; then blood-letting, chiefly local, must be used, with aperients, and salines, according to the strength of the patient, and the degree of fever present. These may be followed by blistering or tartar-emetic counter-irritation in proportion to the continuance of the inflammatory symptoms. But it is not to be forgotten that perforation of the pleura and its consequences are almost always added to a previously existing disease, tuberculous phthisis: and the degree of advancement that this may have reached must much limit the propriety and efficacy of the measures for this accidental inflammation that has been excited. The same considerations are to be kept in view when, in consequence of the smallness of the perforation, or its valvular condition, air accumulates in the chest, and becomes the cause of oppressive dyspnoea. The immediate indication in this case is, doubtless, to give exit to the air by puncturing the chest; and this has been done in several instances with great temporary relief. But before this operation is prescribed, it should be considered whether, as the relief from it will be but temporary, the condition of the patient be such as to make this likely to outweigh the pain and risks of the operation. These certainly are not great; but when added to the dubious view in which the friends of the patient may regard an operation which proves but imperfectly successful, they are sufficient to deter us in many cases from recommending it. The case is different when the accident occurs before the consumptive disease has advanced far, when there is much flesh and strength, and when the physical signs have shown that there is a large proportion of sound lung. The operation may be repeated if the air accumulate again. As it is impossible to avoid the continued introduction of air into the chest, the mode of performing the operation is a matter of much less consequence than in empyema. It is more desirable to puncture below the level of the liquid, to allow this as well as the air to escape.

PLEURODYNIA.

Nature and characteristic symptoms of the various kinds of pain in the chest, and their treatment.

The affection usually called Pleurodynia is generally considered to be of a rheumatic character, either in the intercostal muscles, or in the fibrous fasciæ lining the chest. If it occur singly, it may be of little consequence; but if connected with constitutional rheumatic disease in other parts, whether attended by

much fever or not, it is not to be lightly thought of, for it may readily be converted into a pleural or pericardial inflammation.

It not unfrequently happens in sensitive frames, particularly those of females, that an acute pain suddenly seizes some part of the chest, causing shortness of breath and perhaps cough, very like the stitch of pleurisy: but there is no heat of skin, and the pulse, although often quickened, is not hard. The respiratory motions and sounds may be diminished by the restraining influence of the pain; but the other physical signs of pleurisy are wanting. There is no friction sound, or dulness on percussion; but there is sometimes a continued dull rumbling sound produced by the vibrating contraction of the muscles, which is kept up by the sensation of pain. These affections appear to be neuralgic, and are often connected with a condition of the system the very opposite of inflammatory, such as that which comes on after considerable losses of blood, or when the blood is in an impoverished state, as in chlorotic females. Sometimes they occur in connexion with the periodic plethora of irregular menstruation, and are relieved when the catamenia flows. In such cases blood-letting relieves the pain, but often at the expense of the natural function.

There are other kinds of pain in the chest which may be called nervous, such as those associated with indigestion and a disordered stomach: they are generally referred to the sternum, and in the case of gastrodynia are so severe, as to cause great apparent dyspnoea. Pains are also felt in the chest and shoulders, from a congested state of the liver.

The *treatment* of nervous pains of the chest must be directed more to the condition of the system inducing them, than to the part which seems to be most affected; for it may be at one time the chest, at another the abdomen, or a limb that is the seat of these pains. Sinapisms, hot fomentations and stimulants, or anodyne liniments or plasters, will generally relieve the pain. Where the nervous irritation seems to arise from an undue depression or depraved state of the vascular functions, as in chlorosis, the careful administration of tonics, especially steel medicines, with due attention to the state of the excretions, will be most beneficial. When the pain seems to be the result of misdirected rather than of excessive nervous influence, as in amenorrhœa without chlorosis, those remedies are indicated which tend to draw blood and nervous irritation towards the uterus, such as small doses of aloes, the hip-bath, and for a more continued effect, wearing flannel over the hips and thighs, and riding on horseback. If blood is to be drawn at all for temporary relief, it should be by leeches to the inside of the thighs. The application of three or four every night for four or five successive days, sometimes brings on the natural relief when all other means have failed. If there be much tenderness at any part of the spine, all the symptoms may sometimes be relieved by leeches applied to that part.

Nervous pains unconnected with menstruation may be treated with narcotics both externally and internally. Pleurodynia of a rheumatic kind will require the treatment commonly useful in the form of rheumatism, with which it happens to be associated. It is not necessary here to enter into farther details on these subjects.

PNEUMONIA.

General symptoms of acute pneumonia.—Anatomical characters.—Sanguineous congestion.—Red hepatisation.—Suppuration, or yellow hepatisation.—Gangrene.—Physical signs.—Indications by physical signs of the situation, extent, and stage of pneumonia.—Varieties and complications.—Typhoid pneumonia.—Complication with bronchitis—with pleurisy, constituting pleuro-pneumonia—with phthisis—with the various forms of fever.—Pneumonia and purulent deposits in the lungs after injuries and surgical operations.—Diagnosis.—Prognosis.—Causes.—Treatment of the first stage—of the second stage—of the third stage.—Application of the treatment to particular cases.—Of chronic pneumonia—its anatomical characters, symptoms, and treatment.

PNEUMONIA, Gr. *πνευμονία*, *peripneumonia*, *περιπνευμονία*, *pneumonitis*, *pulmonitis*, (from *πνευμων*, *pulmo*, a lung, or the lungs,) are names given to inflammation of the parenchyma of the lung. These terms were applied by Hippocrates and other ancient writers to most of the acute diseases of the chest unattended with severe pain, those connected with this symptom being by them termed *pleurisy*. Although this ground of distinction by no means holds good with our improved knowledge of the subject, yet we shall find, in opposition to the opinion of Cullen and some modern writers, that between pneumonia, pleurisy, and bronchitis, there is a distinction founded in pathology, and most important in practice.

The characteristic symptoms of pneumonia may be given as follows:—fever, with more or less pain in some part of the chest; accelerated and sometimes oppressed breathing; cough with viscid and rusty-coloured expectoration; at first the crepitant rhonchus, afterwards bronchial respiration, and voice with dulness on percussion in some part of the chest. We shall find, however, that many of these symptoms are not essentially connected with pneumonia, which, with more precision, may be defined pathologically, as inflammation and its product in the parenchyma of the lung.

Symptoms. Acute inflammation of the lungs is, like other phlegmasiæ, accompanied by fever, which often commences with rigors prior to any other symptoms, but sometimes preceded by the local symptoms. The fever is generally very intense, and in plethoric individuals accompanied by flushing of the face, injection of the eyes, headach, and other signs of local determination of blood. The pain in the chest, which when present usually appears early, varies much in degree, being sometimes intense, and sometimes diffused and dull; frequently it is a deep-seated feeling of heat and weight rather than of pain. It generally seems to be deep-seated in the chest, under the sternum, the breast, or the scapula; when more at the side, it is often more acute, and this is frequently, but not always, caused by the extension of the inflammation to the pleura. There is commonly more or less cough, which aggravates the pain; it is short and dry at first, or accompanied with scanty mucous expectoration, and is by no means proportioned to the intensity of the inflammation, being in some cases so slight as to escape notice. The shortness or quickness of breathing is also an early symptom, and a better index of the extent of the disease: but it is to be judged by the number and forced character of the respirations, rather than by the feelings of the patient which are often deceptive. The number of respirations in a minute (which in the healthy adult is about twenty) may rise to thirty and upwards. In some cases, particularly where the attack has been sudden, or has supervened on previous disease of the lungs or heart, the dyspnoea is more urgent, obliging the patient to assume a particular attitude, which is commonly on the back with the shoulders elevated. Muscular efforts, and particularly speaking, bring on or increase the

oppression. The pulse is quick, and in most instances sharp; sometimes but less commonly it is hard, and it generally loses this character as the disease advances. There are, moreover, the other symptoms of fever, such as thirst, furred tongue, loss of appetite, scanty and high-coloured urine, pain in the head and limbs, and weakness. If blood be drawn it exhibits the buff coat. The febrile irritation varies greatly in character, sometimes affecting particular organs, as the brain, causing delirium; the stomach, inducing sickness; the liver, giving rise to jaundice, and other bilious symptoms; and in many cases the fever, instead of being inflammatory is typhoid, producing a variety of the disease which will be afterwards noticed.

In the course of a day or two, the cough becomes accompanied by the expectoration of a rusty-coloured sputum of various shades, semi-transparent, tenacious, and coherent: at first it does not differ from that of acute bronchitis except in colour, which is light reddish or rusty, sometimes passing into an orange-yellow or even a greenish tint: as the disease proceeds, the tint becomes more pronounced, and the viscosity greater. When the characteristic sputa appear, the dyspnoea is often increased; and if the pulmonary inflammation be extensive, the oppression is urgent. The pain on the other hand is often diminished, though sometimes it continues and prevents the patient from lying on the affected side.

In favourable cases the disease may decline on the third or fourth day, with a general alleviation of the symptoms. This is generally first evinced by the skin becoming more cool and moist, and the expectoration less tinged and viscid, and more abundant and opaque, like that of declining bronchitis. Sometimes the improvement is rapid, the patient being restored to convalescence in six or eight days; but it is often more protracted, slight exacerbations recurring every evening, and prolonging the disease for a fortnight or more. The quickness of pulse, cough, and slight dyspnoea are the symptoms which are most apt to linger, with the temporary recurrence of the sanguinolent tinge in the sputa: these are to be regarded as signs of a lurking disease, which a slight cause may aggravate and bring to a relapse. In more formidable cases, the increase of the disease is apparent on the third or fourth day, by the quickened respirations (sometimes amounting to forty or sixty in a minute,) occasionally obliging the patient to sit up; sometimes by more frequent cough, though this is by no means constant; by the greater viscosity and deeper tinge of the sputa; the more weak and rapid pulse; more depressed state of the bodily powers; the loaded or dry tongue; the hot skin, or its feeling cold and partially perspiring. Sometimes there is delirium or coma, which are dangerous symptoms, especially in old persons, and often disguise the nature of the disease. Laennec justly describes comatose symptoms as of more unfavourable import than fierce delirium.

The progress of fatal cases is marked by increasing failure of the strength and more hurried breathing, but the feeling of dyspnoea is not always increased in proportion, sometimes it is even diminished. The cough is less effectual in discharging the sputa, which sometimes retain their viscosity and sanguinolent hue. In most instances there is a total suppression of the expectoration for some hours before death; in others, it is still voided, but in an altered state, being a thin transparent or dirty mucus, or an opaque dirty brown or greenish fluid, consisting of a mixture of mucus and pus, with a little blood. In some cases it has a very fetid odour; in others the thinner reddish-brown fluid, noticed by Andral, like prune juice or liquorice-water, is that last expectorated. With these changes in the expectoration, the pulse becomes thready, very frequent, and often irregular; the countenance pallid and cadaverous; the lips livid; the skin cold and bedewed with cold sweats; the breathing gasping, with an increasing rattle in the throat; the sensorial functions give way, and the patient dies asphyxiated.

When the disease terminates favourably, the amendment is often accompanied by some critical evacuation, such as perspiration, a lateritious deposit in the urine, expectoration, diarrhoea, epistaxis, hæmaturia or some other hæmorrhage, or the menstrual discharge: of these the first four are by far the most common, and the

first two are often conjoined; but the critical evacuation varies with the cause of the disease and the nature of the prevailing epidemic. The observations of Andral have in some degree confirmed the opinions of Hippocrates and other authors, ancient and modern, that on certain days the symptoms show a tendency to abate. These are especially the seventh, eleventh, fourteenth, and twentieth days. In ninety-three cases observed by Andral, the recoveries on critical days averaged fourteen, on non-critical little more than three. In these favourable cases, after continuing with greater or less intensity for the various periods just mentioned, the symptoms become evidently ameliorated; the dyspnoea subsides; the cough becomes less constant and more easy; the expectoration less viscid and tinged, and more opaque and free; and the pulse less frequent, often with an increased fulness. The fever also abates; the skin becomes cool, soft, and moist; the tongue cleaner, and the thirst abates. Some quickness of breathing and of pulse generally linger after the other symptoms, and often cough with bronchitic expectoration, which may remain for some time, and pass through the changes observed in acute bronchitis.

In recovery from pneumonia, relapses are by no means uncommon: they are marked by a recurrence of the chief symptoms, pain, shortness of breath, cough, and viscid sanguinolent expectoration. The fever is less acute than at the first attack; hence a relapse, if serious, may be less tractable.

We shall have occasion to revert to the character and variety of the general symptoms, when treating of the pathology of the disease and the physical signs.

Anatomical characters. The first condition produced in the lung by inflammation is *sanguineous congestion* or *engorgement*, in which the vessels are then so much distended, that the whole tissue appears red, of different shades, and is much heavier than usual, but still crepitates. In some cases a frothy serum exudes when a section of the lung is made; this is probably the effect of the coagulation of the blood after death, for it is not observed in those cases in which the blood remains fluid. It is a common notion that the blood in an inflamed lung is effused into the air-cells, but for several reasons we are inclined to believe that it is contained chiefly in the distended vessels and in the tissue, although it may be occasionally extravasated. Andral examined an inflamed lung after drying and slicing it, and the only difference which he could perceive in its structure was, that the membranes between the cells were somewhat thicker and redder than natural; but there was not that obliteration of the cells that might have been expected if they had been filled with blood. In typhoid pneumonia, and that from asphyxiating gases of the sedative kind (such as those generated in sewers,) the inflammation often does not go beyond this stage, and when it does, it passes at once into a half gangrenous, half purulent destruction of the lung, there being apparently in these cases some change in the vital properties of the tissues, or in the condition of the blood, which incapacitates it from supplying coagulable lymph, the deposition of which constitutes the next stage.

The second stage of pneumonia, *red hepatisation* as it is called, brings the lung to a state of solidity more or less approaching that of the liver. But the transition from the first stage is not sudden but gradual, being the result of the same overflow of the nutritive function, which causes the effusion of lymph in the inflamed pleura. The tissue of the lung, thus consolidated, is so heavy that it generally sinks in water; but it is also more fragile than usual, so that, on being pressed, it breaks down under the finger. This softening seems to be chiefly the consequence of the interstitial deposit of soft fresh lymph, which diminishes the molecular cohesion of the tissues; and the more acute and recent the inflammation is, the greater generally is the softening. The colour of a hepatised lung varies much according to the quantity of blood left in it: if this be much, it is red; if little, pinkish-brown; or reddish-gray, if mixed with the black pulmonary matter. The deposition of lymph seems to supersede the red particles, or possibly it may be formed at their expense. When a hepatised lung is cut into or torn, numerous little granulated points, of the size of pin-heads, and of a lighter colour than the rest,

are often observed. These granules Andral first represented to be the single air-cells or terminations of the bronchi, and he conceived that they were distended with the same viscid mucus secreted by their mucous linings, which is seen in the sputa. Laennec considers these little bodies, the air-cells, converted into solid grains, by the thickening of their parietes and the obliteration of their cavities by a concrete fluid. From many minute examinations which we have made, we have been long convinced that the granulations of hepatised lungs contain no appreciable quantity of viscid mucus, but that they are probably portions of vesicles and minute tubes, with their tissues distended with an interstitial deposite of lymph, and occasionally having the same matter in their interior. In his work on *Pathological Anatomy*, Andral has expressed a similar opinion. But hepatised lungs do not always present this granulated appearance; sometimes there is a uniform condensation of a deeper red than usual. This condition Andral refers to a more complete obliteration of the cells, a farther degree of solid effusion; but this would not agree with its redder colour. We are disposed to view this non-granular kind of hepatisation as the result of inflammation confined more to the plexus of vessels and intervesicular tissues, and less affecting the membranes forming the cells: hence the consolidation partakes more of the character of the vessels and the blood which they convey, and less of the lighter coloured deposite which the membranes of the cells secrete. The recent researches of MM. Hourmann and Dechambre, on the pneumonia of the aged, confirm this view: they have been led to distinguish the granular hepatisation from that of a more uniform aspect; and they designate the first as the result of *vesicular* pneumonia, the other of *interlobular*. Having been the first to describe the latter as a separate form of pneumonia, we prefer the term *intervesicular*. When the blood remains fluid, the consolidation is imperfect, and the portion of lung thus affected, although it may sink in water, is quite soft and resembles the substance of the spleen rather than that of the liver; hence it has been called *splenisation*.

The third stage to which inflammation brings the lung, is that of *suppuration*, or *yellow hepatisation*. This consists in the conversion of the semi-solid particles of lymph or blood, which constitute the solid or red hepatisation, into an opaque, light-yellowish, soft, friable matter, and finally into a liquid pus. This suppuration is commonly diffused in the form of purulent infiltration; and it is rare to find it assume the character of a distinct abscess. We see a sufficient reason for this in the very porous structure of the lung, which renders the circumscription of the matter by the effusion of lymph, such as that which takes place in abscesses in general, a very unlikely result; and the life of the patient, or the vitality of such a delicate and porous structure as that of the lung, is generally destroyed before the process of suppuration can be completed. Hence, even where the suppuration has advanced farthest, there is generally much of the tissue of the lung remaining, and a gangrenous condition is often added to the suppuration, giving the matter a very offensive odour. Nevertheless, circumscribed abscesses in the lung are now and then met with, and this is generally when the inflammation is limited, or more intense in one part, so as to tend to the early formation of pus, whilst the adjoining parts are still capable of throwing out a circumscribing lymph. In this way we have seen abscesses arising from pneumonia, affecting separate lobules: thus, too, abscesses are formed around foreign bodies within the lung, such as a musket-ball, and around calcareous and scrofulous tubercles, which may act as foreign bodies. In all these cases the inflammation of the most irritated parts reaches the stage of suppuration long before that of those around them; and the latter thus forms a separating wall of effused lymph, which may afterwards constitute a kind of cyst. The purulent deposite that are sometimes met with in the lungs of individuals who have died after surgical operations, wounds, or other injuries, generally present this circumscribed character.

Gangrene unconnected with suppuration is a very rare sequel of pneumonia. It may, however, be caused by the inhalation of noxious gases, which seem directly to destroy the vitality of the lung. The lungs of those who have died

some days after being nearly asphyxiated in sewers, have been found reduced in parts to a dark brown, greenish, or livid softening, having a very fetid odour, and being probably the result of the poisonous influence of the gas on a congested lung.

The state of the tissues adjoining the vascular plexus, which is the proper seat of pneumonia, is worthy of notice. The interlobular cellular texture sometimes partakes of the general redness, and sometimes it is singularly free from it, or has it so much less, that a section of the lung is quite marbled by its lines, which are of a lighter colour. So, also, in the hepatised stage the interlobular septa retain their cohesion, and in more chronic cases sometimes become more thick and hard than usual. The mucous membrane of the large and middle-sized bronchi is almost always more or less inflamed, and presents the striated aspect that is also seen in the more acute forms of bronchitis. That of the smaller bronchi is often of a deeper red than in bronchitis; but from its bluish tint this would appear to arise rather from the blood under it than in it. The bronchi in the inflamed part, generally but not always, partake of the softening of the parenchyma. We have in a few instances found some of them plugged with coagulated lymph, as described by M. Reynaud and Dr. Stokes; but this by no means occurs so frequently as to strengthen the opinion of these writers, that pneumonia is generally a plastic inflammation of the minute air-tubes and cells. When this albuminous exudation does take place, M. Reynaud has shown that it may cause the obliteration of some tubes, which would lead to the dilatation of others. More commonly the air-tubes, as far as they can be traced, contain more or less of the slimy rusty mucus, like that which has been expectorated. The pleura is generally, but by no means constantly, inflamed: we have seen it free from redness, lymph, and liquid effusion, even where covering a hepatised portion of lung.

The cases of pleuro-pneumonia in which the inflammation of the pleura is so considerable as to modify the course of the parenchymatous inflammation, will be considered hereafter.

Physical signs. On applying the ear or a stethoscope to the chest of a person with incipient inflammation of the lungs, a fine crackling sound accompanying the respiratory murmur is heard generally in the inferior and posterior region of one side. In its slighter degrees it is scarcely more than an unusual loudness and roughness in the vesicular murmur, as if the air met with slight short resistances in its passage, which destroy the smoothness of the sound; but in its more pronounced degree there is a distinct crepitation, like that heard when common salt is thrown on a hot iron, or like that caused by rubbing between the finger and thumb a lock of hair near one's ear. This, which is the *crepitant rhonchus*, is first heard at the commencement of inspiration and at the end of expiration; but it soon accompanies the whole respiratory act, and in advanced degrees of the first stage it is heard only at the end of inspiration and the beginning of expiration.

The physical cause of the crepitation of pneumonia has been the subject of some difference of opinion. M. Andral considers it to be produced by the passage of air in minute bubbles through serum effused in the smallest air-tubes and vesicles, and that the fine and even character of the crepitation depends on the fineness of the bubbles in these tubes. Thus, he supposes that this crepitation differed from the mucous rhonchus only in the size of the tubes in which it is produced, and the consequent size of the bubbles in them. This opinion has been adopted by several writers, who reduce the liquid rhonchi of catarrh and the crepitant rhonchus of pneumonia to two heads, large and small crepitation. From a consideration of the pathology of pneumonia, and of the course exhibited by its physical signs, we have long been led to consider the crepitation which attends the first stage as distinct in nature from the other rhonchi. We have before had occasion to notice, that the structure and motions of the lungs tend to bring all liquids secreted in the minute tubes into those of larger size, whence

they are ultimately collected in the trachea, and expelled by expectoration. Were the crepitation of pneumonia dependent on serum in the smallest tubes and cells, we ought to have proof of the presence of this serum in the other tubes by a bubbling rhonchus, if not in the expectoration also. But in most cases of the first stage of pneumonia, the chest is remarkably free from bubbling sounds in the large tubes, the rhonchi, if any, are dry, sonorous, or sibilant, and the expectoration is not serous but viscid. In fact, there is good reason to suppose that the serum which exudes from an engorged lung after death, and which Andral assumed to be the cause of the crepitation, is chiefly the result of a cadaveric change, the coagulation of the blood in the distended vessels, which does not take place during life. But what is the condition of the extreme air-tubes and cells in the first stage of peripneumony? They are narrowed and partially obstructed by the enlarged vessels which are distributed between and around them; and as the smallest tubes are narrower than the cells in which they terminate, it is easy to conceive that they are so far obstructed that the air can pass through the viscid mucus lining them only in successive minute bubbles, the bursting of which constitutes the crepitation in question. This appears to be the true view of the crepitant rhonchus; and we can thus understand that at first the crepitation must be slight and confined to the period of the respiratory movements in which the tissue is most collapsed; that as the narrowing increases, it extends to the whole movements; that subsequently the obstruction is such that it permits the crepitating passage of the air only when the lungs are most expanded, as at the end of inspiration and at the beginning of expiration; and finally, that the obstruction becomes complete, and the crepitation ceases, except perhaps still on a forced respiration.

Dr. Stokes has made the important observation, that a *peurile* or unusually loud sound of respiration precedes the occurrence of crepitation in pneumonia, and he considers this to denote the first stage of the inflammation. We question the propriety of calling this another stage, which probably is only a degree of the same condition which causes crepitation, the partial narrowing of the tubes, which renders the sound rougher and louder, before the crepitation begins. The sound of respiration becomes weaker as the crepitation comes on, and extends to more of the minute tubes: and it ceases when the abnormal sound occupies them all. If the disease be extensive, and the function of the lung much infringed on, the energy and frequency of the respiratory movements will be increased, and consequently the respiratory murmur on the sound side will be louder than usual, having the character of *puerile* respiration.

The loud or, to use another term, the harsh respiration, depends in part upon the rapidity of passage of the air through the portions of lung which are not congested, and in part upon a commencing resistance presented by the inflamed cells. The crepitant rhonchus itself depends partly upon the tough liquid contained in the cells and finer bronchial tubes, and partly upon the same resistance of an inflamed and indurated tissue. G.

The increased matter of the congested lung will have farther effects on its properties with regard to sound. It will deaden the sound on percussion, so that the affected side will give a sound rather duller than the opposite side, and different degrees of force in percussion will not materially affect this variation. But the first stage of inflammation, without liquid effusion, is insufficient to make the sound on percussion quite dull; for even in its most advanced degree, there is still enough air in the lung to give some elastic resistance to the walls of the chest, and to leave their vibrations pretty free. The motion of the affected side will be diminished in proportion as the air fails to get admission to the inflamed lung; and instead of being fixed in a state of permanent distention as in *pleurisy*, or in a state of contraction, as in *spasmodic asthma*, the side holds an intermediate size, measuring on full inspiration less, and on the completion of expiration more, than on the sound side. The increased density of the congested lung also makes it

conduct sound better than the light spongy condition of the healthy organ; so that in extensive inflammation, even during the first stage, and whilst the crepitation still continues, there may be heard some degree of the bronchial respiration and vocal resonance that are fully developed only in the stage of hepatisation.

The deposition of lymph which constitutes hepatisation of the lung, completes the obstruction of the minute tubes and cells: hence all crepitation and vesicular respiration cease, and the only sounds which reach the ear are those of the air and voice in the larger tubes, and these are transmitted by the consolidated lung with unusual loudness. The respiration is no longer heard with its prolonged murmur; but in the neighbourhood of the bronchial tubes there is a *short whiffing*, confined to parts only of the respiratory act, and often ending abruptly with a click. This bronchial whiffing is not to be heard in every case, but only when the hepatisation involves bronchial tubes of some size, and is most commonly found in the middle regions of the chest. Here, too, both may be heard and felt various degrees of morbid bronchophony, or vocal resonance. When the consolidation of the lung is very complete, and involves especially the central parts of the lung, the voice may be heard to sound over a space of considerable extent in the mammary, scapular, or axillary region, and so loudly, that it resembles pectoriloquy, for which it is sometimes mistaken. The bronchophony of a consolidated lung may generally be distinguished by its being extended over a considerable space, and by its being much diminished by using the stethoscope with the stopper, which is not the case with the pectoriloquy of a cavity. The vocal resonance of the tubes is also transmitted to the walls of the chest, as a vibration or fremitus which may be distinctly felt by the hand placed on the affected side, and which is much stronger than that on the healthy side. This sign, the discovery of which is due to M. Reynaud, affords an easy mode of distinction between a hepatised lung and a pleuritic effusion, for the latter generally abolishes pretty completely the vocal vibration. The dullness on percussion is now pretty complete, but it is seldom so uniform and general in the lower and middle portions of the chest as the dullness from liquid effusion. We see a reason for this on examining a hepatised lung: there are generally some lobules or portions retaining enough of air to prevent them from sinking in water: this is also sufficient to prevent the stroke sound from being uniformly and perfectly dull; and when the consolidation is perfect, it transmits the stroke of percussion to deeper-seated parts, which then yield their resonance. Thus on the left side a hepatised lung sometimes gives the tympanitic resonance of the stomach; and near the sternum, or in the mammary, axillary, or scapular regions, we may occasionally have the tubular resonance, or bottle note of the large air-tubes. It is not difficult to distinguish these sounds from that of healthy percussion; and when once we understand the cause, their presence and properties will serve rather to instruct than to confuse us. In the stage of hepatisation the lung being nearly inextensible, the corresponding walls of the chest are nearly motionless; and they are so in a state, neither of distention nor of contraction, without fulness of the intercostal spaces, or displacement of the viscera; and thus we have farther distinctions between this case and that of pleuritic effusion. When the left lung is solidified, it transmits the sounds and impulse of the heart to an unusually wide extent of surface, instead of diminishing or displacing them as a pericardial or a pleuritic effusion does.

In the third or suppurative stage there is no change in the condition of the lung, which can modify the physical signs until the effused matter begins to liquefy; and then there is a mucous or bubbling rhonchus from the secretion into the air-tubes. There may be a change in the expectoration, either to pus or to the liquorice-water-like liquid, described by Andral, and which seems to be a sero-mucous fluid, coloured by hæmatine in an altered state: this kind of sputum, however, we have found to succeed to pulmonary hæmorrhage more commonly than to pneumonia. More generally there is no expectoration, or such only as proceeds from the upper tubes, and therefore gives no evidence of the state of

the lung. In fact, we are to infer the supervention of the third stage from the duration of the disease and the general symptoms, rather than from the physical signs. The inflammatory symptoms and fever give way to great prostration, rigors, cold sweats, a quick, weak, thready pulse, whilst the breathing is as short as ever, and the countenance exhibits the pallid, waxy, anxious, drawn, tremulous features of ebbing vitality.

The formation of abscess is less unfavourable, because it implies less extent of suppuration, and a power in the structure to circumscribe it. There are several cases recorded of recovery from pneumonia after the signs of abscess had manifested themselves. Dr. Stokes describes a case in which the cavity became obliterated by a cartilaginous septum, during a complete recovery and enjoyment of health in the pursuit of a laborious occupation for twelve months, at the end of which time the individual was again attacked with pneumonia, which proved fatal, and its effects were found to have been curiously limited by the cicatrix of the former abscess. The signs of abscess are those of a cavity communicating with the bronchial tubes, first containing liquid and air, and producing a course bubbling or gurgling sound on coughing or deep breathing, and, after the expectoration of pus, a cavernous or hollow respiration with pectoriloquy, or loud resonance of the voice, in some part of the chest corresponding with the affected spot. These abscesses are not uncommonly of a gangrenous character; and then there is added to the signs a putrid fetor in the matter expectorated as well as in the breath of the patient. As our limits do not permit us to enter into minute details, it may suffice to point out how the physical signs of pneumonia indicate the situation and extent of the inflammation; and, as far as relates to the diseased organ, they may guide us in the prognosis and treatment. Thus a crepitant rhonchus heard throughout a whole lung, or a considerable part of both lungs, implies extensive disease: if heard at the root of the lung, or at its apex, that is, at the scapulæ or under the clavicles, it indicates a more severe form of the disease than if heard only at the lower parts of the lung in the back. The extension of this crepitation, or its presence in new parts, is a proof of the increase of the inflammation. Its cessation, and the substitution of bronchial respiration and perfect dulness on percussion, are proofs of its advancement to the second stage. On the other hand, the return of the crepitation and resonance, where it had been replaced by bronchial respiration and dulness, announces a progress towards cure by the absorption of the obstructing lymph, and by the air again getting a straitened admission into the cells. As this process proceeds, the act of respiration accompanied by crepitation becomes longer in duration, until it equals in length that on the healthy side; but the sound is still for a time somewhat whiffing where it has been bronchial; and a crepitation of a looser, less even character, also remains after apparent cure: this is the sub-crepitant rhonchus, and probably depends on the presence in the smallest bronchi of a little thin serous mucus, such as that which is seen in the expectoration, and the secretion of which seems, as in bronchitis, to assist in removing the depositions left by the inflammation. If the inflammation have proceeded to the stage of hepatisation, and particularly if it have verged on that of suppuration, in which the albuminous deposit, becoming opaque and lower in vitality, is less susceptible of absorption, the restoration of the texture of the lung to its natural light condition requires a considerable period of time, even after the apparent cure of the disease; and during this period there remain more or less of the physical signs just noticed, as well as some dulness on percussion, and perhaps also not a full power to expand that portion of the chest. We suppose here the cure to become perfect eventually, but to require a long time; though there are other cases in which inflammation of long duration produces permanent changes in the lung, as the obliteration of some portions of the tissue and the dilatation of others: these changes happen most frequently when the inflammation is modified by a cotemporaneous effusion in the pleura, which will be noticed hereafter.

Varieties and Complications.

The form termed *typhoid pneumonia*, whether it be secondary to continued fever or primary, and originally attended by low adynamic fever in consequence of the constitution having been lowered by excesses or extreme privation, or by the depressing influence of foul air, or of an unhealthy season, differs remarkably from common pneumonia in many of its phenomena. The local symptoms are by no means prominent; and although there may be pain, cough, and very disordered breathing, the obtuse state of the mental faculties prevents attention from being drawn to these symptoms. The general functions are however greatly disordered; the pulse is very quick, small, and weak; the skin harsh, dry, and partially hot, or covered with a clammy sweat, and sometimes covered with petechiæ, or suffused with a dusky rash; the tongue is furred, brown, and dry, the alvine excretion dark and unusually offensive; and the urine is scanty, turbid, and ammoniacal. The lungs in such cases are sometimes found after death so engorged, particularly but not exclusively their posterior portions, that they sink in water: the texture is very soft and fragile, and when broken exudes a dark grumous blood: there is only an imperfect approach to hepatisation; but the texture in some parts occasionally shows a softening of a lighter colour, which seems to be an imperfect suppuration. Sometimes partial hepatisations are found, and slight films of lymph on the pleura; and in such cases it is not uncommon to find similar marks of slight recent inflammation also in the pericardium and peritoneum. We have observed this particularly in cases of external erysipelas.

The physical signs in such cases are, in the posterior parts of the chest, dulness on percussion and absence of the respiratory murmur, with an occasional short whiffing and sibilant rhonchus; but, as Dr. Stokes has remarked, there is often no crepitation, or, if it be present, it soon ceases, the obstruction becoming complete. In the anterior parts of the chest, the breathing sometimes remains quite distinct, although accompanied by sonorous and sibilant rhonchi. The signs of obstruction remain for a very long time, and the sound of respiration and percussion is much slower to return than in acute peripneumonia. Dr. Stokes has observed, that recovery in these cases is very slow, and sometimes attended by contraction of the affected side.

We are disposed to consider this affection as partaking of a congestive more than of an inflammatory character; and Dr. Hudson, in an able paper on typhoid pneumonia published in the *Dublin Medical Journal*, has taken a similar view. By some unknown cause, whether in the condition of the blood in the affected capillaries, or in both, the blood stagnates in particular viscera, generally to some degree under the influence of gravitation; and the functions of the organs are proportionately impeded or disturbed. There is at the same time more or less irritation, which may give to the congestion the semblance of an inflammation; but its products are imperfect and irregular; and neither by the free effusion of plastic lymph, nor by the formation of pus, is a true inflammatory organism manifested. We can see why this condition in the lung may be unaccompanied by the usual signs of the gradual formation of a crepitating obstruction, because the engorgement is at once produced, and renders a greater part of the tissue impervious to air. But this degree of congestion, if it occupy the middle parts of the lung, may give bronchophony and bronchial respiration.

The complication of *pneumonia with bronchitis* is very common: in fact, in almost every case of pneumonia the bronchi are also inflamed; but sometimes the bronchial affection is primary and extensive, and inflammation of the parenchyma is superadded. In such cases, if the bronchial secretion be considerable, the noisy rhonchi which it occasions mask the physical signs of peripneumony; and in consequence of the depressing influence of the same cause on the respiratory function, the general symptoms also are more than usually obscure. But on listening particularly at the end of inspiration on the posterior and inferior regions

of the chest, which correspond with the lower margins of the lobes, the fine crepitation may generally be heard if pneumonia is present. The rusty tinge of parts of the sputa, and, as the disease proceeds, the greater dulness on percussion, will also become apparent when the inflammation has extended to the pulmonary plexus of vessels. Of the forms of bronchitis that occasionally pass into pneumonia, those of epidemic influenza, whooping-cough, and those accompanying fevers and diseases of the heart, may be mentioned as presenting this combination.

Pleuro-pneumonia. The effects of a concomitant pleurisy on the pathology and signs of pneumonia are highly deserving of notice. Whenever the inflammation extends from the lung to the pleura, it may be supposed to increase the serous secretion, and perhaps lead to the effusion of lymph; but when the pulmonary inflammation has existed first, and become extensive, these pleuritic products are commonly of small amount. When the inflammation has attacked the parenchyma and the investing membrane nearly to an equal degree, constituting the disease called by Laennec *pleuro-pneumonia*, the effusion in the pleura by its pressure modifies the effects of the inflammation in the lung. The lung is found after death consolidated, but more tough and red than in the state of ordinary hepatisation, and totally destitute of the granular aspect. It much resembles the substance of some muscles; hence Laennec termed this condition *carnification*. It seems to exhibit the more essential part of inflammation of the lung; the sequel or effect, effusion into the coats of the air-cells, which constitutes granulation, having been prevented by the pressure of the external liquid effusion. This combination is therefore also slower in progress than simple pneumonia: the degree of the inflammation as well as the quantity of its product is restrained by the external pressure, and it scarcely, if ever, proceeds beyond the second stage. But this slower rate of progress tends to make its effects also more permanent. If false membranes are formed on the pleura, they have time to become firmly organized, and to bind down the lung in its compressed state; and the lymph effused in the tissue itself, scanty though it be in comparison with that of a hepatised lung, may become the means of adhesion and permanent contraction of the compressed cells and finer tubes, and of consequent obliteration of more or less of the proper tissue of the lung. There is an ulterior result which has hitherto escaped the attention of pathological writers. When the liquid effusion is removed by absorption, and the chest becomes again capable of expansion, what will supply the place of the obliterated cells? The chest remains to a certain degree contracted as after pleurisy; but the atmospheric pressure will also at each inspiration be brought to act on the larger air-tubes that are yet unobstructed; the air can no longer reach the smaller branches or cells of these tubes, so it must dilate the tubes, and make their increased size in some degree compensate for their defective terminations. *Pleuro-pneumonia* is then, as we have before had occasion to remark, a cause of dilatation of the bronchi. We have met with several examples of this kind; and on referring to the records of other cases of extensive dilatation of the bronchi, we have found several in which the symptoms are described to have originated in an inflammatory attack like *pleuro-pneumonia*; and probably all those cases in which the dilatation affects one side only, and in which there is much consolidation of the lung with some contraction of the chest, originate in this way.

The general symptoms of *pleuro-pneumonia* are not materially different from those of the more simple inflammations, but they are often less severe, and sometimes very obscure. The physical signs are a combination of those of pneumonia, and of liquid effusion in the pleura. At first there is crepitation; but this becomes indistinct, as the lung is pushed aside by the liquid; whilst the dulness on percussion is much more marked than in pneumonia, at least in the lower parts of the affected side. In the central regions of the chest, bronchial respiration and bronchophony are soon produced by the condensed lung being pushed against the walls; and if a thin layer of liquid intervene, the bronchophony ac-

quires a loud buzzing accompaniment, like the voice in the performance of *Punch*: in fact, the sound seems to consist of two voices, which probably arises from some of the vibrations being modified into a buzzing or bleating, by passing through the thin layer of liquid, whilst other vibrations pass unchanged. The vocal resonance is generally louder in pleuro-pneumonia than in either pleurisy or simple pneumonia; which probably arises from the chief tubes being pressed more closely against the walls of the chest, with complete condensation of the vesicular structure. The same circumstance sometimes gives the amphoric or tracheal sound on percussion in the mammary region, which forms a singular contrast to the dulness of other parts. We have also found the respiration quite tracheal in this spot, and the resonance of the voice quite as loud as that of caverns. These phenomena become more remarkable in cases which from inefficient early treatment become chronic, the consolidation of the lung remaining permanent; for, as the liquid is absorbed, the bronchi become dilated, and exhibit the phenomena of pectoriloquy, cavernous breathing, &c., as described under *Dilatation of the Bronchi*.

Pneumonia frequently attacks patients in both the early and advanced stages of *tuberculous disease*. Sometimes it is partial and readily yields to treatment: but not a few fall victims to it when it is more general, and this sometimes in the absence of symptoms sufficient to distinguish it from the pre-existing disease. Again, it is not unusual to find miliary tubercles in the lungs of these in whom the ordinary treatment of pneumonia had proved unavailing.

The pneumonia which sometimes supervenes in continued fevers, small-pox, erysipelas, scarlatina, and in various chronic diseases during the prevalence of epidemic peripneumonia, is generally of a congestive or typhoid kind, and often appears to be the immediate cause of death. In many such cases the symptoms of the pulmonary affection are often very obscure.

The bronchial affection of *measles* sometimes passes into pneumonia, especially when the eruption disappears suddenly with continuance of fever; here the symptoms are generally pretty evident. A congestive and latent inflammation of the lungs is sometimes a complication of *endemic and periodic fevers*; and the reaction of the collapsed stage of *malignant cholera* and *asphyxia* is peculiarly apt to fall on the lungs.

Several surgical writers have noticed the occurrence of pneumonia after severe *injuries* and *surgical operations*. It is often latent, and may declare itself only a short time before death, by the oppressed breathing and rattle in the tubes. In some instances of this sort the lungs are found only in the first stage of inflammation; in others there are circumscribed hepatisations; and not a few present the singular lesion of purulent deposits in the pulmonary tissue. These deposits are always well-circumscribed, the tissue around being sometimes inflamed, sometimes healthy; they are at first of a red colour with a brighter margin, and interspersed with pink, drab, or yellow spots, the latter appear to be sections of the vessels, and on being pressed exude pus. In a more advanced state more of this lighter colour is seen and gives the appearance of purulent infiltration, whilst on the margin of the deposit a distinct coat of lymph can be traced, circumscribing the diseased part. In a few cases, the process of suppuration has been found completed in the formation of an abscess. These fatal sequels of injuries are to be considered as the result of a diseased state of the blood rather than of true pneumonia. Pus is probably formed in the blood or elsewhere, and deposited in the lungs on account of their great vascularity, where it is circumscribed by secondary inflammation; sometimes it is deposited in other organs.

Diagnosis. Under this head we need only pass in review some of the more distinctive signs of pneumonia, and the chief points by which it may be distinguished from the diseases which most resemble it. The general symptoms, when all grouped together, often sufficiently characterize the disease, but their occurrence and degree are very uncertain, and by no means constantly announce its amount or even its presence. Of the single symptoms the expectoration is certainly the

most characteristic. The rusty tinge is considered by Andral and others to be quite pathognomonic of pneumonia; but we have seen it in various degrees communicated to the bronchial mucus by congestions which are not inflammatory, as in bronchitis supervening on organic diseases of the heart, causing great pulmonary congestion, and also after pulmonary hæmorrhage. It sometimes happens, too, that there is no expectoration, especially at the onset of the disease, and in the case of young children it is seldom brought to view. The crepitant rhonchus, in conjunction with the general symptoms, may be more safely depended on, for its presence is more constant, and its extent and progress well represent the amount and state of the disease. Increasing dulness with bronchial respiration and sound of the voice equally mark the transition of pneumonia to the second stage. From pleurisy, pneumonia may be distinguished in the first stage chiefly by the crepitation and expectoration; in the second, by the bronchophony and vocal vibration sensible to the hand, and by the absence of signs of displacement of the walls or organs bounding the lungs, and of any change by posture in the sound of percussion. From bronchitis, pneumonia may commonly be distinguished by the crepitation, which is finer and more equal than that of bronchitis, by the rusty tinge of the sputa, and, as the disease advances, by the dulness on percussion, bronchophony, and bronchial respiration. The skin is hotter and less livid than in severe bronchitis; neither is the cough or the dyspnœa generally so urgent. From pulmonary apoplexy, or hæmorrhagic congestion, it may be known by its febrile commencement and course, by the absence of any real hæmoptysis, and by the crepitation and dulness on percussion being progressive, and rarely so circumscribed as in pulmonary apoplexy. Inflammation is, however very commonly engrafted on pulmonary apoplexy. Œdema of the lungs and tuberculous disease in their physical signs may resemble pneumonia, but their history and general symptoms will in most instances sufficiently distinguish them.

Prognosis. Pneumonia must at all times be viewed as a serious disease, and the prognosis even in favourable cases should be given with caution, as cases which are at first slight may take an unfavourable turn, and in progress towards recovery, as long as the disease lasts, there is a chance of relapse, which may throw the patient into new danger. The circumstances which chiefly affect the prognosis are the stage of the inflammation, its seat, its extent, its complication with other affections, and the state of the general health and strength. As this disease in its progress tends to the disorganization of the lung, so its continuance increases its danger; hence the prognosis is more unfavourable if hepatisation has taken place; and still more so, if the signs seem to indicate the supervention of the third stage. The duration of the stages varies very much in different cases, according to the violence of the inflammation, the age of the subject, and the effects of the remedies. Laennec states the average duration of the first stage (engorgement,) at from twelve hours two three days; the second (hepatisation,) from one to three days; the suppurative from two to six: remedies which retard the progress of the disease prolong the period of the first two stages. We think even these statements more precise than the subject will admit of, for the duration of the first two stages presents a remarkable variety in different cases. In children, and in some epidemics, also in adults, the first stage may last for more than a week, without the production of hepatisation. On the other hand, in aged and debilitated subjects, the inflammation may speedily reach the stage of suppuration. Laennec describes this to have taken place in some instances within twenty-four hours. Recovery may take place from every degree of pneumonia; but the chances of this are very small, when it is probable that suppuration has taken place. Even simple hepatisation requires time and favourable circumstances to effect the absorption of the effusion. Until there is evidence of the advancement of this process of absorption, as well as improvement in the general symptoms, the prognosis must remain doubtful; for inflammation may readily return in the lung around the hepatised portions. The supervention of a gangrenous odour in the expecto-

ration is a formidable event; but not a hopeless one, for a few cases in our own experience, and several on record, have occurred in which recovery took place.

The extent of the inflammation greatly affects the danger of the case. A double pneumonia affecting both lungs at the same time is frequently fatal even in the first stage; and whenever the whole of one lung is involved, there is great peril of an unfavourable issue. Inflammations attacking the upper lobes and root of the lungs are more fatal than those confined to the lower lobes: a result which may be the consequence of the former containing blood-vessels of larger size.

The complication of pneumonia with other diseases generally increases its danger. It is often fatal when supervening on the different forms of fevers, on gastro-enteric, bronchial, pericardial or peritoneal, inflammations, and in these cases it is very apt to be latent. Pleurisy on the same side may diminish the intensity of the pulmonary inflammation, but if it attack the opposite side, it adds to the oppression and danger. Pneumonia is more than usually fatal during pregnancy and in the puerperal state, and at the extremes of age, especially in weakly infants, in cachectic old people, and in those exhausted by habitual excesses. The fatality is much greater among the lower classes than among those well and regularly fed and clothed. Besides the preceding circumstances, the general health and vigour of the subject, the severity of the chief symptoms which indicate the state of the vital functions, especially the dyspnoea, the pulse, the expectoration, and the mental faculties, and the influence of the remedial measures which have been employed, all must be taken into account in estimating the prognosis in particular cases.

Causes. It is well worthy of remark, that bronchitis and pleurisy affect vessels which freely communicate with those of the parenchyma; but although they do occasionally extend to the latter vessels, and thus excite peripneumonic inflammation, yet they are generally quite distinct from it both in their present course and in their ulterior effects, and require a distinction in treatment which should be borne in mind. We find an explanation of this difference in the peculiar character and importance of the pulmonary blood-vessels; in their great number and capacity; in the large proportion which they bear to the other solids of the lung; and in their great liability to congestive distention. This extensive and important plexus of vessels, through which the whole blood of the body passes, is, as we have before seen, peculiarly liable to distention from any cause which may disorder the function of the heart or lungs. Thus all those causes which tend to induce asphyxia, produce also that congestion of the pulmonary vessels which, added to irritative reaction, may constitute inflammation. Thus we see that various causes which disturb greatly the balance of the circulation, particularly by deranging the passage of the blood through the lungs, may become causes of pneumonic inflammation. Of these the most remarkable are, long-continued exposure to cold, asphyxiating poisons, congestive fevers, violent exertion, diseases of the heart, bronchitis, asthma, wounds, tubercles, and foreign bodies in the lungs, and the moribund state. Pneumonia is so frequently complicated with whooping-cough, measles, and small-pox in children, that it forms one of the chief sources of the danger in these diseases. The same remark applies to many forms of continued fever in adults. In common with other inflammations, it may be occasioned by the suppression of habitual discharges. The inflammations of gout, rheumatism, and cutaneous diseases, are rarely transferred to the lungs. Cold is unquestionably the most common cause: this is especially shown by its prevailing almost exclusively in the cold season, and chiefly in March and April, during the continuance of cold winds. The epidemic occurrence of the disease has been repeatedly noticed. Laennec conjectures that the epidemic cause is often not merely change of temperature but deleterious miasms in the air, which exert a specific operation on the lung, as the poisons of the rattlesnake and of some fungi are said to do. Huxham observed that, during an epidemic, bronchitis prevailed in low damp places, and pneumonia and pleurisy on more elevated situations. Although met with chiefly in cold countries, milder climates are not free; it occurs to a great extent in the south of France and Italy; where however the winds cause great and sudden

changes of temperature. Its frequent occurrence in the neighbourhood of Vesuvius may perhaps be attributed to the noxious exhalations which prevail there.

Treatment. The indications of treatment in pneumonia vary according to its stages. In the first stage, the chief object is to remove the inflammatory irritation and congestion from the pulmonary vessels; in the second there is another indication, to promote the removal of the interstitial effusion, the product of the inflammation; even in this stage, when the strength fails, and more particularly in the third stage, it is necessary as far as possible to support the functions which are oppressed by the extent of the organic lesion induced. Particular symptoms may also give occasion to other indications in every stage. We shall shortly notice the principles which may guide us in the use of remedies to fulfil these several indications, and then advert to the application of the treatment in the different forms and complications of the disease.

Treatment of the first stage. Distention of the great pulmonary plexus of blood-vessels being the first condition of pneumonia, from whatever course it may proceed, we may hope in the early stage of the disease to relieve it by blood-letting, as well as to prevent the process of reaction which renders it essentially inflammatory; and in some instances, where the local signs announce the presence of the disease in its first stage, and the general symptoms prove it to be of a sthenic character, the free loss of blood by one venesection will arrest the progress of the disease. But when the vessels have been so long distended and become the seat of fixed irritation so much, that the mere removal of pressure from the sanguiferous system at large will not enable them to recover their usual size, a single blood-letting may not be sufficient; it must be repeated as often as the strength will bear it, and other remedies must be used, which also have the power to counteract the inflammatory irritation. Of these the most important are tartarized antimony and mercury. M. Louis has inferred from an application of numerical calculation to certain cases of pneumonia, that early blood-letting never arrests the disease, and that it only shortens its duration by four or five days. It is clear, however, that many of the cases classed by Louis as pneumonia, were instances of the asthenic or typhoid disease; an affection certainly in treatment, if not in pathology, differing widely from sthenic or acute pneumonia. We suspect also that a great prevalence of similar cases, and the absence of the fully sthenic character among the pneumonic patients of the Meath Hospital, have led Dr. Stokes to conclude that one, or at most two, bleedings will be sufficient, and that local blood-letting is the principal remedy.

The utility of tartarized antimony in emetic and nauseating doses in pectoral inflammations had long been recognised, but its power of subduing acute inflammation, independent of its emetic, nauseating, or diaphoretic effects, was first pointed out by Dr. Marryatt of Bristol, and farther developed by Rasori of Genoa. Its peculiar efficacy in pneumonia was especially shown by Laennec, who considered its value to be above that of blood-letting. Chiefly to the efficacy of this remedy he ascribes the uncommonly small mortality of only two in fifty-seven cases which he states to have been the result of his practice of late years. He gave the medicine in doses of from one to two and a-half grains in three ounces of sweetened weak infusion of orange-leaf, withholding the medicine after the sixth dose, or preserving it according to the severity of the symptoms. This remedy has now been successfully employed by many practitioners at home and abroad, and its efficacy seems pretty well established, but not to the degree claimed by Laennec. In this country it is considered as subsidiary to blood-letting; and it has not been found useful to give the large doses which Laennec sometimes employed. From half a grain to two grains in an ounce and a-half of some agreeably flavoured liquid may be given every second, third, or fourth hour, according to the severity of the case. The first dose commonly causes vomiting, but this generally ceases after the second or third, and if it should not, two or three drops of the diluted hydrocyanic acid will generally stop it. If it causes purging, it may be useful to combine a small quantity of opium with the antimony. The mode in

which tartar-emetic acts is not well understood. Its antiphlogistic power does not essentially depend on its nauseating, emetic, purgative, or diaphoretic effects; for although these are occasionally induced by it, yet it is as often quite as successful where none of these effects has been produced. It appears to be directly antiphlogistic by a specific action on the inflamed vessels; this, although not an explanation, is as intelligible as the specific action of remedies on the vessels of the intestinal canal, the liver, or the kidneys. Some pathologists, particularly the followers of Broussais, suppose tartar-emetic to act as a kind of internal blister, inflaming and causing pustules on the gastric mucous membrane; and Andral cites two or three cases in which such a condition was found after death. But these are rare instances; and among very many in which we have seen it used we have never met with any in which, with due discretion in its administration, any symptoms of permanent gastric irritation have resulted from its use. In the wards of Laennec we have seen patients taking twenty grains daily, not only without experiencing sickness, pain, or diarrhœa, but even without losing either appetite for food or the power to digest it. Such a quantity is however by no means necessary; we have never found it useful to exceed ten or twelve grains in the day, and a smaller quantity often suffices. After blood-letting judiciously employed, this remedy has appeared to us the best for reducing the inflammation in its first stage, if properly administered: it will often prevent the necessity of farther loss of blood; but as Drs. Graves and Stokes remark, its use must be continued for some time after the apparent amelioration of the general symptoms; and it must not supersede farther bleeding should the symptoms indicate the propriety of this measure.

The exhibition of mercury and opium as a remedy in inflammations was first practised in this country by Dr. Hamilton of Lyme Regis: it is now very generally employed as an antiphlogistic, after and together with blood-letting. The efficacy of mercury depends in great measure on its being given to such an extent as to affect the gums; but its beneficial operation is often apparent before this effect is produced, and in some instances, as in children, without its occurring at all. But there is seldom that speedy improvement, which is often apparent after the first doses of tartar-emetic: the operation of mercury is more gradual, and as might be expected, when once the system is under its influence, the effect is more permanent. It is therefore more adapted to the less active forms of the disease and to the second stage. Calomel is the form of mercury generally preferred in acute inflammations; and as its purgative effect is not an object, it is necessary to combine it with opium, except the first dose, with which it may be useful to clear the intestinal canal. With this view, from five to twenty grains of calomel may be given alone after the first bleeding; and subsequent doses of from five to twelve grains with a grain or a grain and a-half of opium, and the same of ipecacuanha three or four times in the day until the gums be affected, will generally be found suitable for the more sthenic cases. Smaller doses more frequently repeated answer better in less acute cases, and those with more semblance of continued fever. Where there is a tendency to diarrhœa, the Hydrarg. c. Cretâ in larger doses may be substituted for calomel. In apportioning the doses of mercury and opium we must be guided by the features of the individual case. The opium acts as an anodyne in allaying the pain and cough, and as a sedative in quieting that nervous irritation which often follows free blood-letting and the use of mercury, whilst the injurious stimulant and astringent effect of opium is counteracted by the mercury and previous blood-letting. But the chief action of the mercury appears to be of that specific kind which enables it to remove the product effused by inflammation, as we see visibly illustrated in the case of iritis.

It may be supposed that in an inflammation so deep-seated as pneumonia local blood-letting is but of inferior efficacy, and is useful only as an aid to venesection, when from the local pain there seems to be inflammation of the pleura: or after general bleeding has been carried to a full extent, a decided impression on the symptoms may be kept up by local bleeding together with tartar-emetic or mercury. Counter-irritation in the early stage during the prevalence of fever causes

too much excitement, but it becomes of use when the pulse has been reduced; and in typhoid cases blisters may be used from the commencement. They also much promote the dispersion of the congestion, which even the first stage of inflammation leaves in the lung. Little good is to be anticipated from purgatives, diuretics, diaphoretics, or sedatives until the violence of the inflammation has been reduced by blood-letting; then each of these kinds of remedies may be indicated by the symptoms. The same observation will also apply to expectorants in all but the slighter cases, in which there is obviously a natural tendency to relief by expectoration: in such instances the decoction of senega with tincture of squills and solution of acetate of ammonia or an alkali may considerably promote this discharge.

Treatment of the second stage. When the physical signs announce that the lung has already become extensively consolidated, with little remains of crepitation, the treatment must be conducted on a different principle from that of the first stage. Solid matter is already effused, and no amount of blood-letting or other means of depressing the circulation can remove this. Their utility is therefore much more limited, and is chiefly confined to the removal of any increase of irritation or congestion, or to reduce the bulk of the blood to the capacity of the abridged state of the respiratory organs. The most powerful remedies are those which modify the action of the diseased vessels, and promote the absorption and elimination of the effused matter. Mercury is the most efficacious of these, and calomel the most convenient form. Its combination with opium assists its effect, and tends to allay the pain and cough which may be present, as well as the nervous irritation which is very apt to occur after depletion has been carried to a full extent.

As the consolidated state of the lung often remains for a long time, even after the inflammatory action has been subdued, a great variety of remedies, according to the state of the general symptoms, may become necessary in this stage. Thus, besides the antiphlogistic means before mentioned, some of which must be used as long as crepitation is heard in any part of the lung, more aid may now be derived from external counter-irritation by blisters of tartar-emetic, and from expectorant mixtures containing an alkali. According to the state of the pulse, heat of skin, cough, pain, &c., these mixtures may be saline, with digitalis, squill, and liquor potassæ, or in a less sthenic state decoction of senega, camphor, squill, &c., with acetate, muriate, or even carbonate of ammonia. We have found these alkaline salines exert considerable influence in promoting expectoration and in dispersing the solid recent product of inflammation in the lung. If such measures with external counter-irritation be neglected because the general symptoms are relieved, there is great risk that the hepatised portions of lung may become the seat of chronic disease or that acute inflammation may be re-excited around it, and there is more danger of these evil consequences in scrofulous constitutions and where the inflammation has been of less acute character. When the fever has entirely subsided, and the symptoms of local irritation are inconsiderable, although the physical signs show that a portion of the lung remains consolidated, a combination of liquor potassæ and hydriodate of potash with decoction of senega or sarsaparilla will sometimes assist to restore the healthy state of the lung.

Treatment of the third stage. When from the supervention of rigors, cold sweats, feeble, very rapid, or irregular pulse or other signs of prostration, it is probable that suppuration has commenced in the lung, the utility of antiphlogistics wholly ceases, and if any thing may be yet done by medicine, which can rarely be hoped, it is by remedies of a stimulant kind, especially those which may lend to assist the respiratory forces to expectorate the matter which accumulates in the tubes; such as carbonate of ammonia, tincture of lobelia, ether, and camphor, in decoction of senega, or wine, or hot spirits and water. Nor are such remedies to be restricted to the third stage; they may be indicated whenever the vital powers fail, and when the sthenic character of inflammation has

entirely ceded to its ulterior and opposite result—depression from incapacity of the disabled organ. Under all such circumstances, the general symptoms are better guides to practice than the physical signs, for the whole frame then suffers as well as the function of the lung, and requires more immediate attention.

When from the fetid odour of the breath and expectoration, it is probable that a portion of the lung has lost its vitality, the treatment must still be guided by the general symptoms. If these betoken the persistence of active inflammation, the gangrene is probably circumscribed, and antiphlogistic remedies must still be used; but if they have given way to the adynamic symptoms, the use of stimulants is indicated even more imperatively than in the suppurated stage. Dr. Stokes gave the chloride of lime combined with opium in a case of gangrene of the lung, with a temporary effect of removing the fœtor of the breath and sputa, and of greatly improving the constitutional symptoms. We have used the nitromuriatic acid with the same view, to counteract the septic influence of the putrescent matter in the system, and apparently with good effect. In one instance the patient recovered, although the physical signs had showed the existence of a large cavity in the posterior lobe of the right lung with great fœtor of the breath and expectoration. Laennec recommends bark or sulphate of quinine in large doses in gangrene of the lung, even when accompanied by extensive hepatisation.

We now proceed to point out the application of the treatment to particular cases. Where the disease is at all severe, the treatment with tartar-emetic or with calomel and opium should be commenced immediately after the first bleeding, and continued uninterruptedly until an impression is produced on the disease. It is not safe however with either of these remedies to lay aside blood-letting: if obvious relief do not ensue in the course of five or six hours after the first full bleeding this measure must be repeated either generally or locally, as the strength may bear it, and again on the next day if necessary.

In the more acute cases, uncomplicated with gastric disease, we have found advantage from combining the mercurial with the antimonial treatment, by giving a pill containing from 5 to 10 grs. of calomel with from $\frac{1}{2}$ to $1\frac{1}{2}$ gr. of opium every four, six, or eight hours, and in the intervals the tartar-emetic draught, and where the tolerance is soon established the effect of this combination is very powerful. If the bowels be too much acted on, the Hydr. c. Cretâ in double quantity may be substituted for the calomel. When an improvement takes place in the symptoms, the mercury may be given at night only, or omitted altogether, and the case left to tartar-emetic and whatever depletion or counter-irritation may be required.

If the attack of pneumonia be very recent, and accompanied by a pleuritic stitch in the side, or catch in the breathing, a full dose of opium after a large bleeding, as recommended by the late Dr. Armstrong, will sometimes succeed in cutting short the disease. This plan can be adopted only where the bleeding has been so copious as to produce a great impression on the heart's action, almost if not quite amounting to syncope. The dose of opium should be large; two or three grains of the aqueous extract, or, if the pain and tendency to reaction be urgent, from thirty to sixty minims of the liquor opii sedativus, or of Squire's tincture of bi-meconate of morphia, will generally succeed best. Even in this case we think it advisable to give from six to twelve grains of calomel soon after the opium: it does not interfere with the sedative operation of the latter, and by preserving the balance of the secretions it prevents those functional derangements which sometimes follow the use of opium even in this way.

If the disease have to any extent passed into the second stage, and even if the first have lasted twenty-four hours, there can be little hope of subduing it by opium; and we must then trust to the other remedies. Blisters can seldom be used with advantage until all fulness and hardness of the pulse and heat of skin have subsided; and either these symptoms or the continuance of a fixed pain would counter-indicate the use of senega and other mild tonics and expectorants, which are otherwise useful in the decline of the inflammation.

The great fatality of pneumonia among children renders it necessary that its treatment should be directed with the greatest promptitude and care. This fatality does not arise so much from the course of the inflammation, as this is less rapid than in adults, but from the latency of the local symptoms, and the tendency of the disease in a disguised form to pass the period in which remedies are most effectual. Hence many infantile cases of pneumonia, particularly among the lower classes, are in an asthenic state before we are summoned to treat them; the depressing influence of the injured function of the lungs having already removed the sthenic character of the disease. This shows the importance of physical examination of the chest in all the febrile affections of children, in order that if any crepitant rhonchus be discovered, the fit remedies may be promptly used. In this early stage, blood-letting is very efficacious; but when used after the disease has lasted for several days, it sometimes produces convulsions and sinking without relieving the breathing. The same observation applies to tartar-emetic, which, if used together with blood-letting soon after the commencement, will seldom fail to subdue infantile pneumonia uncomplicated with tubercle. Mercury acts in children more on the bowels than on the gums, causing green feculent evacuations: it is of great efficacy, and our chief remedy when blood-letting is no longer borne. In children there is little risk of arresting the expectoration by purgatives: it would seem that as it is a less natural process in early life, expectoration is of less consequence than in the adult. Counter-irritation with mild tartar-emetic ointment or solution is of great benefit in the after stages of pulmonary inflammation in children, and should especially be persevered in when there is any sign of a phthisical tendency.

In aged persons the disease being generally of an adynamic or typhoid type, is often intractable in consequence of the great debility which accompanies it. Advanced age alone, however, should not restrain us from blood-letting where the state of the breathing, heat of skin, and the pulse seem to require it. Frank bled an octogenarian with pneumonia nine times with a good result. Such cases are however exceptions; for the period in which blood-letting is useful in old people is short, and often restricted by a complication with humid bronchitis. Expectoration is here an important process, and may sometimes be aided by some of the remedies just mentioned, with the mercurial or tartar-emetic treatment and blisters at an earlier period than usual.

The typhoid form of pneumonia requires a treatment considerably modified. Blood-letting not only is very ill borne, but it appears to have very little influence on the disease. There seems to be in the pulmonary vessels a loss of tension or tonic, and we might empty the great blood-vessels, and stop the heart's action before the congestion of the lungs would be relieved and their vessels enabled to contract. Besides, the depressing influence of typhoid diseases renders any loss of blood hazardous, and local depletion is the utmost that can be attempted. Considerable advantage may under these circumstances be derived from dry cupping on the chest; which for the time tends more effectually than even blood-letting to draw the fluids from the congested organs whilst it does not drain the blood from the system. Blisters and sinapisms also may give relief in slight cases, but their effect is limited, where, as it commonly happens, the whole posterior part of both lungs are congested with blood which is itself probably in a morbid state. The principal remedy in this form of pneumonia (if pneumonia it can properly be called) is mercury, which may be combined with opium and saline medicines, and, in case of great prevalence of the adynamic symptoms, with stimulants and tonics, such as wine, ammonia, and bark. Medicine has often very little power in these cases; but as far as our experience goes, stimulants judiciously given when the heart's action, as examined by the stethoscope, is feeble, and diminished or withdrawn as soon as it becomes increased, and the pulse sharp or hard, have appeared to relieve the pulmonary affection as well as to support the strength. Musk is highly recommended by M. Recamier in

typhoid pneumonia: he gives it in doses of from twenty-four to thirty grains, with an effect which he almost considers specific.

It may be questioned whether the affection called intermittent peripneumony, and said to have been cured by bark, is really an inflammation; it is more probable that it consists of a simple congestion of the lung, just as similar congestions are more familiarly known to take place in the spleen and liver, and which, when recent, give way to bark or arsenic, not to blood-letting. We have stated that typhoid pneumonia, and that attending continued fevers, are more properly to be viewed as congestive than inflammatory; at the same time it must not be forgotten that congestion may by a process of reaction be converted into acute inflammation with all its products, and otherwise, unless soon removed, frequently tends to produce some chronic change of structure.

The complication of pneumonia with bronchitis is generally best treated by moderate blood-letting followed by the antimonial treatment. Blisters and expectorant mixtures are of more avail than in simple pneumonia, the disease often terminating by free expectoration.

In pleuro-pneumonia local as well as general blood-letting should be practised freely; and after the more acute stage has subsided under the influence of these and of antimony, if the buzzing bronchophony and dulness on percussion still continue, the side should be blistered repeatedly, and a mild course of mercury prescribed to promote the removal of the fluid and the interstitial lymph which might lead to partial obliteration of the tissue of the lung.

In pneumonia supervening on hooping-cough and influenza, it is sometimes a chief indication to give sedatives to allay the cough, which appears often to have a considerable share in producing the parenchymatous inflammation; with this view the sedatives recommended for hooping-cough should be combined with the usual treatment.

Where an inflammatory state of the mucous or serous membranes of the alimentary canal accompanies pneumonia, it is of great moment that in the treatment these complications should be considered, as they may render some of the ordinary remedies injurious. Leeches followed by poultices should be applied to the abdomen, and the milder forms of mercury with Dover's powder exhibited, assisted by laxative enemata or very gentle aperients.

Diet and regimen. In ordinary cases of pneumonia the diet should be strictly antiphlogistic, and during the early stages confined to thin mucilaginous or farinaceous liquids. Even these should not be used in excess, for in large quantity any liquid may first distend the stomach and then increase the mass of the blood, and in both ways augment the dyspnea. In those addicted to a very free use of fermented or spirituous liquors, as well as in typhoid pneumonia in general, it is sometimes necessary to continue a certain quantity of these stimuli. M. Chomel found a considerable diminution in the great mortality of such cases on adopting this plan. In gangrene or extensive suppuration indicated by fœtor and copious purulent expectoration with great prostration of strength, it also becomes necessary to give beef tea, animal jellies, and wine; but great circumspection must be used to withdraw them in case of fresh excitement. It is equally necessary to be very cautious with regard to the improvement of the patient's diet during convalescence, by adopting gradual transitions, and by properly regulating the alvine function.

Pneumonia patients should be kept in an airy room without draught, of moderate temperature (about 60°.) It is of considerable importance in the more severe cases to raise the chest above the level of the body by a bed chair: this facilitates breathing and expectoration, and prevents the too free gravitation of the blood to the lungs. In prolonged cases, especially those of a typhoid kind, it is also proper to vary the posture from side to side, and to lying on the face when the patient cannot sit, several times in the day, to prevent the *hypostatic* congestion. This is recommended by M. Gerdy and Dr. Stokes.

CHRONIC PNEUMONIA.

As we have seen with regard to pleurisy, so also in pneumonia, the inflammatory action may not entirely cease with the effusion of lymph, although it do not lead to the third or suppurative stage. When acute inflammation is extensive, and the effusion of lymph is not removed by absorption, the disease generally proves fatal before there is time for farther change; but in circumscribed peripneumonies, or in small parts of more extensive hepatisation, a chronic inflammation sometimes goes on, and produces that kind of tough induration which is the general result of chronic inflammation in a parenchymatous structure. Thus in the lungs of those who have suffered from long and repeated attacks of inflammation of the chest, even where there are no tubercles, we not unfrequently meet with portions of the tissue that are dense, almost destitute of air and of liquid, tough, and sometimes almost cartilaginous. Their colour varies from a dark dingy-red to different lighter shades of reddish-brown and buff, sometimes rendered gray by a mixture of the black pulmonary matter. Their aspect also is varied, like that of acute hepatisation, by the tissues that are chiefly affected being sometimes granular or oolitic (as Laennec has stated) from the especial thickening of individual vesicles; in other cases streaked or veined, from the hypertrophy of the interlobular septa and cellular tissue around the large vessels; in others more uniform and of a darker colour, from the pulmonary plexus of vessels being the chief seat of the alteration, and the colouring matter of the blood entering largely into the deposition. In this last variety the cellular tissue between the lobules is sometimes thickened to the amount of several lines, and is of a light drab or gray colour, like that of miliary granulations, and like them has almost the density of cartilage. These changes, which thus occur as the sequel of acute pneumonia, are also frequently met with, complicated with those states of the lung which are called tuberculous; and a considerable portion of the consolidation that is met with in phthisical lungs often presents the same anatomical characters as these chronic hepatisations which supervene on acute pneumonia imperfectly subdued. These will be farther noticed under PHTHISIS. We have also several times met with these chronic consolidations in the lungs of those who have long suffered from extensive organic disease of the heart, where the circulation of the lungs was perpetually impeded by the structural lesions of that organ; it is probable that the same mechanical congestion from this cause which sometimes lead to effusion of blood in the tissue, constituting pulmonary apoplexy, may if long continued terminate in effusion of lymph, and obliteration and consolidation of the pulmonary texture. This condition of the lung is sometimes coupled with an irregular dilatation of the air-cells; and on examination after death the organ presents a knobby surface, and feels nodulated, where the consolidation occupies lobules or parts. There seems to be reason for ascribing also to a minor extent of chronic inflammation of the parenchyma, that increased density and rigidity of the pulmonary tissue, without entire consolidation, which is often found in the lungs of those who have long suffered from dyspnœa, whether from bronchial or cardiac disease.

The *signs* of chronic pneumonia are those of circumscribed consolidation and obstruction of the pulmonary tissue, which continue long after the urgent symptoms of the acute disease have subsided. The dyspnœa has become less oppressive, but it is still felt on exertion; the fever has been reduced, but there is still some quickness of pulse and heat of skin towards night; there is still some cough; and although there may be improvement in the appearance and strength, it is not progressive, the patient remaining with his organs and functions abridged: there is still partial dulness on percussion, with some bronchial respiration and vocal resonance in the seat of the late inflammation. If in this state the patient neglect the means which may most conduce to the restoration of his general health, as well as to the removal of these remains of local disease, the indurated portions of lung may either prove centres of fresh inflammation, or they may themselves

spread, ulcerate, and commence the career of phthisical disease, which will sooner or later destroy life. We have met with several cases of consumption that have appeared to originate in this way, independently of any distinct tuberculous disease or diathesis; the individuals having been in excellent health, and quite free from all chest complaints before the attack of acute inflammation, which afterwards degenerating into this chronic form laid the foundation of a consumption, and ultimately proved fatal. It is however slower and less intractable in its progress than the true tuberculous consumption, for the disease is more local than constitutional; and if circumstances do not occasion its extension, and injure the constitution by a constant and increasing inroad on the functions of respiration and circulation, it may be in the power of nature, aided by art, to effect its removal.

The subject of the *treatment* of chronic pneumonia will be resumed in connexion with that of phthisis. It may suffice for the present to add that for those cases which succeed to acute disease, the most effectual treatment consists in a mild course of mercury in the first instance, combined with external counter-irritation, followed by a course of hydriodate of potash and sarsaparilla or some similar alterative, with a mild sea-air, regular gentle exercise, and a well-regulated diet.

PNEUMONIA OF CHILDREN.

The pneumonia of children differs in some respects from that of adults. The disease appears in them under two distinct forms, which are almost peculiar to children of certain ages. That is, one form attacks children from birth to the period of the second dentition, while the other does not differ from the ordinary frank pneumonia of adults; and does not, therefore require a separate examination. The two forms are not strictly confined to one or the other age of life, but that which is most frequent in young children is rarely found in those more advanced, while the ordinary form of the disease is extremely uncommon in young subjects.

The lobular pneumonia, which is almost the only form met with in young children, derives its peculiar features in part, from the peculiarities of organization of this age, and in part, from the causes which give rise to the disease. These are generally very prolonged bronchitis, previous disorders of the digestive tubes, or the exanthemata; in short, diseases which depress the powers of life or alter the constitution of the blood, which then gravitates towards the inferior parts of the lungs. In adults, the action of analogous causes is occasionally followed by the same affection, which then produces similar symptoms; and the inflammation of the lung then differs very slightly from the lobular pneumonia in young children.

The peculiar anatomical character of the disorder is, that the inflammation is diffused through several scattered points which are attacked at the same time, or nearly at the same time. These points are single lobules, or parts of lobules, divided by the cellular tissue. The tissue is first congested, and afterwards inflammation sets in, and as the disease extends from point to point it passes along the posterior portion of the lung according to the ordinary laws of pneumonia, but, as it were, in a scattering way, attacking several lobules at the same time. This form of the disease sometimes even passes into suppuration; when it proves fatal it is in most cases rather by depriving a large portion of the lung of air, than by the true inflammatory action and its direct consequences.

The signs of lobular pneumonia are less evident than those of pneumonia of the ordinary form. The respiration is at first rough, and almost always there is more or less mucous and sub-crepitant rhonchus which depend upon the accompanying bronchitis, but there is rarely a dry crepitant rhonchus. The respiration becomes bronchial only in a late stage of the disease, and scarcely ever to as great degree as in ordinary pneumonia, for the bronchial tubes are blocked up by the secretions before the hepatisation is perfect. The percussion is dull; but as this dullness exists nearly to the same degree in both sides of the chest, we lose the advantages of comparison, and can, therefore, with some difficulty detect slight deviations

from the normal standard. In the advanced stages of the disorder there is, of course, no obscurity; but in the earlier stages we must remember that the same dulness is not to be looked for as in ordinary pneumonia, and the evidence of the disease will rest, therefore, on less decided signs.

The treatment of lobular pneumonia consists of two distinct parts, the hygienic and therapeutic. To answer the first indication we direct a mild unirritating diet, and frequent change of position, so that the blood may not gravitate towards the posterior part of the chest: without this precaution all other means of treatment are apt to fail. The apartment in which the child is placed should be of a remarkably uniform temperature, and the clothes arranged in such a way and made of such materials as to prevent any chilliness of the surface.

The therapeutic means are, in the commencement of the disorder, local bleeding by a few leeches or cups proportioned to the age of the child. The advantages of these remedies are, however, limited to but a short period, that is, the earliest stages of the affection; afterwards they debilitate the child without removing the inflammation. Blisters are often of benefit, and are never of mischief if they be applied only for a few hours, and the cuticle then removed by a poultice; but in this disease, as well as in the genuine ordinary pneumonia, they are less certain than many other remedies. The best counter-irritant for most cases is a weak mustard poultice; a very good one consists of thick slices of bread dipped in hot vinegar, and sprinkled lightly with mustard. A common poultice made of roasted onions is often of great benefit; or the bruised cloves of garlic, if they can be readily procured, may be used in preference. The revulsive applications should not be confined to the breast, but may be used to various parts of the body, and especially to the lower extremities by means of weak mustard poultices and baths.

The internal remedies which are most to be depended upon are the preparations of ipecacuanha, of which the best for children are the wine and sirup. This medicine should be given frequently in small doses, so as to facilitate expectoration and thus to aid in the natural cure by secretion from the inflamed tubes. Other remedies of a similar kind are called for in many cases of the disorder; if the child be strong and robust, tartarized antimony is of great benefit; but if the pneumonia follow a disorder of another kind, which has previously debilitated the patient, the antimony is not well adapted for the case. The stimulating expectorants, as senega and the balsam of Tolu, are necessary when the lungs are obstructed with mucus, they may then replace or be given in conjunction with ipecacuanha, according to the strength of the patient. If there should be much bronchitis, and the pneumonia remain in its early stage, free emesis after a dose of ipecacuanha or tartar-emetic, will often relieve the child of the mucus secretions and give such a shock to the circulation of the lungs as will sometimes produce a rapid resolution of the disorder. The main difficulty in the management of the pneumonia of children is not the selection of the remedies, but the persevering employment of them in such doses and at such times as cannot materially affect the strength of the patient; but will still have a powerful action on the local inflammation.

Many other remedies which are useful in certain stages of ordinary pneumonia are appropriately adapted for the pneumonia of children; but these are so various, and require such a knowledge of the particular condition of the case, that no general rules for their employment can be given.

GANGRENE OF THE LUNGS.

In many cases, gangrene of the lungs is not a mere consequence of pneumonia, but depends upon the same causes as idiopathic gangrene of the mouth, or of other parts of the body; that is, it is an immediate result of a vitiated condition of the fluids. In most patients this state follows excessive intemperance, mercurial salivation, or some disease which possesses a powerful influence upon the general health, and brings about that alteration of the

fluids upon which gangrene depends; hence gangrene of the lungs sometimes occurs simultaneously with that of the mouth or other parts, depending upon the same cause.

The physical condition of a lung affected with gangrene independent of pneumonia, is very well understood. The tissue at first is infiltrated with serum, which is sometimes of a dark red or almost purple colour, and at other times grayish; it yields readily on pressure and exhales a fetid odour. This is the first stage of the disorder, and differs but little from that of the first stage of pneumonia, except in the fetor and colour of the infiltrating liquid. In the second stage, the cohesion of the parenchyma is destroyed, it may be washed away by a small stream of water, and at first the blood-vessels and bronchial tubes remain longer than the intervening cellular tissue, the fetor is then decidedly gangrenous, of the peculiar odour of ordinary gangrenous matter, or the smell resembles that of putrid oysters: the colour of the lung is blackish like that of other gangrenous parts. In the third stage the gangrenous lung is replaced by a cavity, which follows the softening and discharge by expectoration of the gangrenous matter. If the gangrene be circumscribed, the cavity is lined by a false membrane, which gradually secretes pus, and finally extends over the whole interior, cutting off the dead from the living tissue. Cicatrization then follows, either by the gradual obliteration of the cavity by cellular substance, or a cyst is formed, which is lined by a smooth mucous membrane continuous with that of the bronchial tubes. If the gangrene be more extensive, death may occur during the progress of the second stage or at the commencement of the third.

The sputa of gangrene of the lungs vary with the stages of the disorder, at first they are mucous and slightly fetid, afterwards they are blackish and similar to prune-juice, or of a dirty grayish tint. In the third stage the proper gangrenous sputa are intermixed with mucopurulent matter from the walls of the cavity; the latter gradually increases in quantity until it forms the whole of the expectoration. As the disease goes on, the sputa gradually pass into the character of simple mucus. The expectoration presents throughout the disease the fetor characteristic of gangrene, especially in the middle of the second stage when the softening is most rapid. The breath of the patient offers the same character, which is more marked both in it and in the sputa after the paroxysms of cough which come on from time to time, and are followed by a copious discharge of the liquid which has been accumulating in the cavity.

The physical signs of gangrene are at first similar to those of bronchitis of the smaller tubes with free secretion, that is, sub-crepitant and mucous rhonchus, they afterwards gradually pass into gurgling and pectoriloquy as the cavity forms.

The diagnosis of the disorder is made from the peculiar odour of the sputa and breath, the physical signs serving only to point out the extent of the disease and the stage of the affection.

The prostration of strength and complexion of the patient are similar to what is observed in ordinary gangrene from accidental causes.

The treatment of the disease should be of a tonic supporting kind, to keep up the strength of the patient during the time required for casting off the gangrenous mass, and filling up the cavity. The sulphate of quinine, porter, wine, and even milk-punch, with as generous a diet as the stomach of the patient will bear, should be liberally given. The solution of the chloride of soda in the dose of twenty drops every three or four hours will generally be borne by the patient, and I have found it of decided benefit. For the same purpose chlorine should be allowed to disengage itself from several saucers filled with moist chloride of lime and placed about the bed of the patient; the gas rises into the lungs, and is thus directly applied to the diseased part. If pleuretic pain should come on, a blister to the chest is the best mode of relieving it.

G.

PULMONARY ŒDEMA.

Anatomical characters.—Causes.—Symptoms and physical signs.—Treatment.

ŒDEMA of the lung consists in an effusion of serum into the tissue, probably both between and within the cells and minute tubes. Its *anatomical characters* are, that the lung is heavier and paler than usual, pits on pressure, crepitates little under the finger, and when cut exudes a frothy serum. It is seldom idiopathic, but like œdema of other parts results from some loss of balance in the circulation, an obstruction to the return of blood, or in a few instances an excess of exhalation. Thus it may arise from the obstructions occasioned by organic diseases of the heart, lungs, or liver, or from the increased exhalation supervening on exanthematous fevers, particularly scarlatina and rubeola, or on those diseases of the kidneys which interfere with their excretory function, and are accompanied by dropsical effusions in various parts.

Being thus a sequel of other disease rather than a pathological condition distinct in itself, the *symptoms* accompanying œdema must vary greatly according to the cause which produces it. When extensive it occasions dyspnœa, cough, and thin mucous or serous expectoration. The *physical signs* are a crepitant or sub-crepitant rhonchus, with the breathing less fine and even than that of pneumonia, and giving proof of the presence of more liquid by the mucous rhonchus in some of the larger tubes. The natural vesicular murmur is rendered indistinct, especially at the lower and back part of the chest, where also the sound on percussion is impaired. These signs are very like those of the first stage of pneumonia; and the distinction is chiefly to be found in the general symptoms; the fever, rusty expectoration, and progressive increase of pneumonia being absent, and there being present œdema of other parts, or other signs of disease that may be supposed to produce it. From our own observation we should say, that the lungs are less liable to œdema than the external cellular tissue; and they are rarely so affected unless there be also anasarca, or œdema of the limbs.

Treatment. This must depend on the nature of the cause, and be adapted to the character of the organic lesion which is generally present. The œdema which follows scarlatina and measles generally yields to hydragogue purgatives and digitalis; in addition to which general or local bleeding may in some severe cases be required.

DILATATION OF THE AIR-CELLS;

OR

PULMONARY EMPHYSEMA.

Anatomical characters.—Causes and nature.—Symptoms.—Physical signs.—Prognosis.—Treatment.—Interlobular emphysema.—Nature and supposed physical signs.

THIS lesion, like others essentially affecting the structure, will be best understood through its anatomical characters.

Anatomical characters. These present some variety, but they have this in common, that when examined either through the pleura in the recent state, or after this membrane is inflated, dried, and sliced, the air-cells are seen much larger than those of healthy lungs. When the dilatation is general the pleural surface of the lungs may be as smooth as usual, only more convex; but when it is partial, there are seen either several enlarged vesicles or lobules forming irregular prominences. Individual vesicles are sometimes seen under the pleura, and especially at the margin of the lobes, dilated to the size of a pea, a hazle-nut, and in some cases to a much larger size. Dilatation may be partial or general: general dilatation may affect one lung, or the whole, or a considerable part of both lungs; partial dilatation may affect all the vesicles of a lobule or be confined to distinct vesicles. These different lesions may be accompanied by very opposite conditions of the texture of the lung: sometimes this has acquired an increased rigidity; it does not collapse where the chest is opened, and resists the impression of the fingers more than a healthy lung. There are, notwithstanding, the dilatation of the air-cells and its general lightness, hypertrophy and toughness of some of its textures, and portions near the root are sometimes found considerably indurated. With this condition there are commonly associated an altered state of the air-tubes, redness and thickening of the mucous membrane, hypertrophy of the longitudinal fibres, dilatation or partial contraction. In other cases, there is the opposite condition of the lung. The texture is more flaccid and yielding than usual; and when the margin of a lobe is pressed between the fingers, it feels thin, almost like a single membrane. It often does not collapse on opening the chest, and this appears to arise from a loss of elasticity, for it pits on pressure like an œdematous lung, and is commonly much paler than usual. This is the condition which M. Lombard describes as *lobar* emphysema; and he remarks that the inter-vesicular texture seems to have been absorbed, and the blood-vessels obliterated, changes which he considers to be the cause, rather than as we view them, the effects of the dilatation. Andral has noticed this condition of the lung, under the name *atrophy*, and remarks that it occurs most frequently in old people. We have seen it both general and partial; the partial kind of flaccid dilatation being common in the anterior lobules and margins of the lungs in tuberculous phthisis. The fringe of dilated cells like a row of beads, sometimes seen at the margin of the anterior lobes, is also simple dilatation, without the least rigidity.

Causes and nature. Laennec explained the origin of this lesion in this manner:—In cases of chronic catarrh, particularly of the dry kind, the small bronchial ramifications become so obstructed by the swelling of their membranes or by the secretion of a viscid mucus that the air can be forced through them into

the vesicles only by an effort. Now, as in ordinary respiration, the inspiration, a muscular effort, is more forcible than expiration, the former may prove sufficient to overcome the obstacle to the introduction of air into the vesicles, while the expiration is inadequate to expel it. Successive portions of the air expanding by the increased temperature are thus introduced and incarcerated in the cells, which are thereby kept in a state of continued dilatation. This may be one mode in which the air-cells become dilated, but there are probably other causes more efficient and common in operation. When there is partial or complete obstruction in any of the bronchial tubes or cells, the inspired air cannot press with the usual force beyond the obstructions; but it presses with more than the usual force into the adjoining tubes and cells to which its access is quite free, and these latter may thus become distended, and in time permanently dilated. The obstructions may be caused by viscid secretion in the tubes, thickening of the textures, tuberculous deposits, and the like; and it is with diseases in which these occur, that dilatation of the air-cells is most commonly associated. Another cause of dilatation of the air-cells is rigidity or want of extensibility of the longitudinal fibres of the bronchi. This change has been already noticed as an effect of chronic bronchitis; and it is easy to perceive, that if the tubes do not lengthen with the expansion of the chest the air will press unduly on their terminating cells, and occasion their dilatation. Thus we find the margins of the lower lobes most dilated, for these are most exposed to the influence of the forces expanding the chest. It is not common to find the marginal vesicles dilated in the lungs of old people with ossified cartilages; which may also be ascribed to the comparatively immobile state of the ribs and central portions of the lungs, and the increased action of the diaphragm, and consequent undue pressure of the air into the texture immediately contiguous to this part of the respiratory apparatus. Such are the chief mechanical causes by which the vesicular texture of the lung becomes distended: but there are others of a more vital nature, which may also be concerned in the production and perpetuation of this lesion.

M. Andral conceives that the air-cells sometimes become enlarged by a wasting away and breaking down of some of their walls, so that several are reduced to few of larger size. This has been shown by M. Lombard to be the case whenever the enlargement of some cells is considerable: but we are induced to consider with Dr. Carswell, that this is a consequence rather than a cause of the dilatation. The latter author has well observed that the long-continued pressure of the confined air on the vessels is a sufficient cause of their diminution, and of the atrophy of the tissues.

Dr. W. Stokes supposes that paralysis of the circular fibres of the bronchi is a chief cause of dilatation of the air-cells. Following the view which Dr. Abercrombie holds with regard to the intestinal muscles, he considers inflammation of the tunics investing the tubes, such as that of bronchitis, to be the chief cause of this paralysis. It is, however, doubtful, that this is more than an aiding cause in the production of pulmonary emphysema. The contractile property of the vesicular tissue is not fully proved; but its elasticity is undoubted, and it is very probable that a defect of this may assist in producing the lesion in question. But the chief agents are probably the mechanical causes of irregular distention of the lungs, which have been already noticed.

Reverting to the anatomical differences of the tense and the flaccid vesicular emphysema, we may well trace in one the effect of an over-active and irregular nutrition of the textures, the common result of repeated or prolonged inflammation, and in the other the absence of any such process, if not the presence of one of an opposite character, causing a wasting of the same parts. It is obvious that these opposite conditions will lead to very different effects in the signs and course of the lesion. In the one case, the lungs become comparatively fixed in a distended state; and as they resist the power of the expiratory forces to expel the air from them, unusual exertion is required in inspiration to introduce sufficient air to serve the purpose of respiration. They are, therefore, perpetually

exposed to a distending force: and as the dilatation proceeds, and the increasing rigidity or obstruction with it, the lungs acquire a permanent volume beyond what is usual even in full inspiration, and they distend the walls of the chest, and press on and even displace the adjoining organs and vessels. Hence may be expected to arise continual oppression of the functions of both respiration and circulation, and, as the sequel, cachectic and dropsical disease of the system. In flaccid vesicular dilatation on the other hand, there is little or no increase of volume of the whole lung, and no pressure on the other contents of the chest.

Symptoms. We are now prepared to understand the symptoms and signs of extensive vesicular dilatation. Inasmuch as it is permanent, it will cause a constant shortness of breath, or even dyspnœa; and the least additional obstruction, such as that of a cold, bodily exertion, or flatulent distention of the stomach, may increase this symptom to an oppressive degree, so as to resemble an attack of asthma. The permanency of the oppression to the function of respiration in severe cases induces a cachectic state of the body, which is manifested by pallidity and some emaciation, and a depraved condition of all the excretions. In the tense form of emphysema, with increased volume of the lungs, there may be superadded the symptoms of obstructed circulation as well as imperfect oxygenation of the blood, occasional lividity and even blueness of the face and lips, dropsical effusions, palpitation and other signs of hypertrophy of the heart. Dr. Stokes has remarked, that these symptoms are always worse in cases where the lower lobes of the lungs are chiefly affected, which he explains by the enlarged lungs of these parts preventing the free play of the diaphragm. The expectoration is various; most commonly it is mixed, a thin dirty, mucous fluid, with portions of tough, pearly clots, or of the opaque sputa of chronic bronchitis. In the attacks of acute bronchitis which frequently occur, it becomes glairy, and often very copious towards their termination, as in bronchorrhœa.

Of the *Physical signs* of pulmonary emphysema, one of the most remarkable is the loud, hollow sound on percussion, which is even greater than that of a healthy chest. This is common to both the tense and flaccid kinds of emphysema; but in the former, when extensive, there is a distinctly *raised pitch* in the sound, such as in a less degree that which can be produced by striking the chest of a person holding in a very full breath. In fact, as in this case, the walls of the chest are rendered more tense by the increased volume of the lung, and the vibrations which they make are therefore quicker although from the elasticity of the contained material they are still quite free. In advanced cases, the increased volume of the lung is manifest in the shape of the chest, which is unusually convex or rounded. The sides, the front, the back, and even the supra-clavicular spaces, some or all present this rounded projection; and as Dr. Stokes has observed, when the lower lobes are affected, the heart, the liver, and the spleen may be displaced by the emphysematous lung, which then yields its clear resonance on percussion over an extended region. In this tense kind of vesicular dilatation the sound of respiration is very imperfect and wheezing, and forms a remarkable contrast to the efforts used to introduce and expel the air. On inspecting the chest it can be seen that, with all the expiratory efforts, it is very little diminished, and retains its large convex shape; whilst every intercostal and every supplementary muscle can be seen at work, endeavouring in vain to depress the ribs. We can scarcely wonder that this force, continually exerted on the thoracic vessels through the stuffed lungs, should obstruct the circulation, and cause lividity, cyanosis, dropsical effusions, and diseases of the heart. Inspiration is more easy, but even this requires exertion, for breath is taken as it were on the top of breath, and needs the supplementary aid of the cervical and superior dorsal muscles. Sometimes there are heard in the chest some odd sounds, besides the various rhonchi of the tubes, such as a sudden, loud clicking or cracking, as if from the sudden passage of air into or out of a set of tubes and cells which were before closed. Sometimes there is a sound of friction like that of a finger rubbed on a table, perhaps produced by the rubbing of projecting lobules or cells against the costal pleura.

The signs of the flaccid kind of dilated air-cells may be much modified by the other disease, such as tuberculous deposit, that commonly produces it; but they are essentially distinct from those of tense emphysema, and this difference has not been noticed by authors. There is the clear sound on percussion, but no raising of the pitch of the sound. In old people, where this form of emphysema is uncomplicated with solid deposit, the sound on percussion is clearer and deeper than in any other case. Neither the shape nor the motion of the chest is materially affected; and the sounds of respiration, instead of being obscure and wheezing, are remarkably loud and even puerile, sometimes with a little whiffing or bronchial character, probably from accompanying dilatation of the tubes. The reason of all this will be apparent when we reflect that, in these cases, air passes freely into and out of the dilated cells; and that their enlarged size, together with the increased energy which the feeling of dyspnoea gives to the acts of respiration, explains why the sound of respiration should be louder than usual.

Prognosis. When dilatation of the air-cells is so extensive as to alter the shape of the chest and to cause constant shortness of breath, there is little probability of its ever being entirely removed, and its general tendency is to increase, especially during the occurrence of any fresh attacks of bronchial inflammation. In some cases the disease, if not congenital, takes its origin in very early life, and the individual is always very short-breathed, and on the occurrence even of a common cold becomes completely asthmatic. But these are not the most severe cases; such are those which supervene to repeated and obstinate bronchial attacks which in the course of a few months may induce a formidable degree of the disease. Even these cases do not prove speedily fatal, but only after the system has suffered much and long, and disease of the heart and dropsy has supervened.

Treatment. The prevention of the disease is more attainable than its cure; and with this view we should endeavour to remove those inflammations which lead to an obstructed state of respiration, and to disperse the obstructions which they produce. The use of counter-irritants and alkaline attenuants and expectorants, and other remedies recommended for chronic bronchitis and dry catarrh, is the most successful mode of effecting these objects. We have seen, in several cases, considerable relief with marked improvement of the physical signs, from the use of small doses of hydriodate of potash and liquor potassæ, with squills and other expectorant remedies. Where there is already evidence of considerable dilatation, blisters to the chest, or frictions with a strong stimulating liniment, and the inhalation of steam impregnated with a little tar, turpentine, creosote, or even iodine, may prove of some benefit. Dr. Stokes mentions strychnia as likely to restore, in some measure, the lost contractility of the circular fibres.

The symptoms which arise in inveterate cases of pulmonary emphysema must be treated on general principles, remembering that although we may be unable to remove the cause, we may, in some degree, prevent its increase and diminish its aggravations from temporary circumstances. With this view care should be taken to avoid the renewal of bronchial inflammation and congestion, by guarding against cold, keeping the secretions free, and carefully regulating the diet. If the expectoration be not sufficiently free, and a fit of dyspnoea occur during the night in consequence, benefit may often be derived from smoking stramonium in the evening: this excites secretion from the bronchial surface, and prevents the congestion which would otherwise ensue during the first sleep.

The flaccid form of emphysema is scarcely an object for treatment: we cannot increase the number of the pulmonary cells; but we may, in some degree, so regulate the body as to diminish the want of breath, and make the small number suffice. With this view, a tranquillizing plan of medicine and regimen, avoiding all excitements of the circulation and respiration, at the same time promoting the due activity of the secretions and tone of the system by gentle exercise and alterative tonics, may serve to keep a balance of imperfect health, and prolong existence on a lower scale.

INTERLOBULAR EMPHYSEMA is an effusion of air into the cellular membrane between the lobules and under the pleura ; and, though essentially distinct from the preceding affection, it may be combined with it. It is distinguished anatomically by the air being in the lines of the interlobular septa, and contained in angular cells of various shapes and sizes, and not round ones like those of the lung. Sometimes air is effused under the pulmonary pleura, detaching it from the lung in large bubbles. This affection is commonly produced by violent efforts, or by wounds of the lung, but sometimes from rupture of the air-cells by excessive or sudden dilatation. It may, if extreme, produce sudden and even fatal oppression to the breathing; but in slighter cases it is of no consequence, and is removed spontaneously.

The only sign, supposed by Laennec to mark this affection, is a sound of rubbing with the motions of respiration, which the projecting emphysematous septa or bubbles make against the walls of the chest. This is heard and felt sometimes in successive jerks, so as to resemble the steps of a person mounting and descending a ladder.

ATROPHY AND HYPERTROPHY OF THE LUNG.

We have already adverted to atrophy of the lung as a concomitant of flaccid dilatation of the air-cells. But the same condition not unfrequently presents itself where there is no distinct evidence of enlargement of the cells ; as in the lungs of aged persons, and of those who have died after a prolonged and emaciating illness. In such cases, the textures of the whole lungs are found much thinner, softer, and paler than usual, and when collapsed, they are shrunk into a very small compass. The cavity of the chest seems to be also diminished by the diaphragm occupying a higher position than usual. There are other cases in which partial atrophy of the lung can be traced in connexion with tubercle, obliteration of the bronchial tubes, and as a sequel of pleuro-pneumonia ; but, in these cases, there is generally also dilatation of either the neighbouring tubes or cells. It is very reasonable to suppose with Andral and Stokes that, when from a permanent obstruction, a part of the lungs do not receive its supply of air and blood like other parts, whose functions are not exercised, it loses its substance ; and it is still more interesting to conceive that the same result may effect more generally the lungs of those whose sphere of respiration is contracted by their being bed-ridden, or otherwise long limited in the exercise of the function. Such individuals, should they recover the power of being active, are short-breathed without any other disease ; and although weakness of the heart and muscles of respiration may partly cause this, we must suppose that the wasting of the lung through disuse is also concerned in it.

HYPERTROPHY OF THE LUNG has been already noticed in connexion with chronic pneumonia and emphysema. But we also meet with the lungs in a denser, heavier state in some other diseases, particularly those of the heart. This has been described by Dr. Clendinning, and, from much observation, we can bear testimony to the fact that, after the long continuance of organic disease of the heart, the substance of the lungs, even when not congested, is much more dense and heavy than usual, although the vesicular texture is every where filled with air. The lesion of the heart with which this state of the lung is most commonly associated, is hypertrophy of the right ventricle, with difficult transmission of blood through the heart ; and we can readily conceive how the increased impulsion of blood produced by the one, and the long existing congestion resulting from the other cardiac lesion, may occasion an increased growth of the solid textures of the lung. The indifferent sound on percussion which the chest often yields in such cases, may result from this change ; and the permanent shortness of breath is, perhaps, also in part due to the same cause. The treatment belongs to the subject of hypertrophy of the heart, and the lesion which it induces.

TUBERCULOUS DISEASE OF THE LUNG, OR PULMONARY CONSUMPTION.

General characters.—Anatomical characters.—Pathology of pulmonary tubercles.—Symptoms—of the first—second—and third stage.—Physical signs—of the first—second—and third stage.—Complications.—Varieties.—Acute—Chronic.—Origin and causes.—Diagnosis.—Prognosis.—Treatment.—Prevention of tubercular disease.

UNDER this head we propose to include all those forms of disease of the lungs which arise from the formation of tuberculous matter, or of depositions and indurations which are allied to it, in the substance of the lung. By the names, *phthisis*, *consumption*, and more properly by that of *decline*, is implied the wasting of the body from the effect of a disorganizing process going on in the lungs. A disease so varied in extent and course as phthisis is can scarcely be comprehended in a definition by symptoms, but its most general character may be stated as follows: cough, with at first little or only transparent expectoration, occasionally hæmoptysis, afterwards opaque, purulent, and copious expectoration; quick pulse and fever, particularly in the evening, and ending with night sweats: dyspnœa, or shortness of breath, gradually increasing; progressive emaciation and debility. The chief physical signs are, irregular expansion of the chest, dulness on percussion, with imperfect or bronchial sound of respiration in some of the upper parts of the chest; afterwards cavernous rhonchus, respiration, and pectoriloquy; indicating partial consolidation of the lung, followed by the formation of cavities communicating with the air-tubes.

But it would be irrational and tedious to enter into any details of the symptoms and history of the disease, without first considering the pathological nature of those changes which it causes in the lung; and as these are chiefly learned by a study of the anatomical characters of the lesions, we shall premise a brief sketch of these; and by tracing out their progress through their stages and complications, we may be enabled better to comprehend the nature of the disease, and the signs and symptoms which accompany it.

Anatomical characters. When we examine the lungs of persons who have died of consumption, we find them greatly changed from their natural condition: they are more or less consolidated in irregular masses; and on cutting into them, they are also generally found excavated into hollows of various sizes and shapes, which are either empty, or contain a thick liquid matter.

The morbid conditions may be arranged under the following heads:

1. On pressing the softer parts of the lung between the fingers, there are felt in it a number of hard little bodies; and on cutting into them they are found to be roundish granules, of a light, semi-transparent reddish drab, or skin-colour, sometimes more gray or ash-coloured, more rarely devoid of colour and quite transparent; of sizes varying from a pin's head to a hemp-seed. Their hardness is considerable, sometimes almost equalling that of cartilage; these are the *miliary granulations* and *miliary tubercles* of Laennec and other writers. They are sometimes found isolated, and studding a tissue otherwise healthy: but more commonly they are in groups of several together: and then they are either clustered in bunches like little berries, or they form a considerable mass, with the interstitial tissue consolidated and indurated between them. They are most commonly distinct in the inferior lobes; in the upper parts, and near the root of the lung, they are usually conglomerated in masses. In the upper parts, too, it is most common to find in them opaque specks of a yellowish-white colour, which are generally in the centre of the granules, sometimes at their margins. In the distinct granula-

tions, the opaque part is little more than a speck; but in those which form a conglomerated mass, the opacity is often seen extending from granule to granule; and in others it constitutes a mass of considerable size within the indurated cluster of granulations.

2. A consolidation of another kind is also commonly found. It is diffused through some extent of the pulmonary tissue, of no particular shape, except that sometimes it seems to be limited to single lobules: it varies in consistence: it is often as nearly as hard as the miliary granulations, and in parts has somewhat of their semi-transparency and colour; but generally it has a darker hue, from the colour of the blood and the black pulmonary matter in it. The consolidation is pretty complete, and the pulmonary texture cannot be distinguished in it, except here and there the coats of a large blood-vessel, bronchus, or interlobular septum, which are often thickened and partake of the induration. In other cases, the consolidation is less perfect; there being still some air in the tissue, and the adjoining portion of lung being often emphysematous. In these indurated masses, are often to be seen, here and there, more opaque light-coloured spots, which are sometimes quite distinct, and of a dead yellowish-white, like those seen in the miliary granulations: but they are here less regular in their shape and size: being sometimes in streaks, curves, and angles, and mottling the dark consolidated texture with spots and patches of a lighter and opaque hue. In the lightest and most opaque spots we recognise what must be described as the next class of morbid appearances to be met with in phthisical lungs, namely,—

3. Opaque yellowish-white masses of various form and size, generally somewhat rounded. Some of these are nearly as solid as the dark or semi-transparent indurations, but they are much less tough; others have more or less of a cheesy consistence; and some are found in parts approaching to a state of grumous fluidity, still retaining their light colour and opacity. These opaque masses are commonly found within the indurations from which they appear to be formed, and they are just of the same character as the specks before described as occurring in some of the single or aggregated miliary granulations. In fact, as these specks are seen (in some in greater number and extent, and preceded by an intermediate state of opacity) in parts to pervade the whole mass, it may be fairly concluded that the clusters and nodules of granulations are also converted into this same opaque friable yellowish-white matter. This matter which is indisputably entitled to be distinguished as tuberculous, is occasionally found also in other situations, unaccompanied by any induration; such as in the interior of dilated vesicles and bronchial tubes, in masses under the pulmonary pleura, and in the bronchial glands. In these instances, it is commonly of a more friable and cheesy consistence, and has not the hardness which it seems to retain for awhile when it has originated in the indurated tissue. But this yellow tuberculous matter, however tough and hard it may be in the first instance, tends to soften, partially or wholly; and thus the masses are sometimes found consisting of loose clots in a puriliginous fluid, or wholly reduced to a curdy or cheesy kind of puriform matter. The tuberculous matter is also not unfrequently found diffused through a considerable extent of the pulmonary texture, constituting the *infiltrated tubercle* of Laennec. In its earlier condition, the lung in this state closely resembles the advanced stage of hepatisation, when the opacity which precedes suppuration shows itself. It is very much mottled or marbled; for, besides the yellowish-white opacity, which is seen in different degrees, there is the black pulmonary matter, giving it a gray or greenish colour, besides the white coats of vessels and interlobular septa, and red spots of tissue less affected. When the lung in this state is cut or torn, which it commonly may be with facility, its interior presents a granular surface like that of hepatisation; and except that its colour is more varied, and it has generally more of the light opacity of tuberculous matter, it resembles a hepatised lung very closely. But in it there are often found what are rarely met with in hepatised lungs—circumscribed abscesses or cavities containing a fluid matter. To this softened and fluid state, then, all the condi-

tions which we have been describing tend to pass, and thus are formed *vomicæ*, the matter of which being evacuated into the bronchial tubes, leave the form of lesion next to be mentioned.

4. Lastly, we find cavities or excavations very various in number and form, and of sizes from that of a cherry-stone upwards to the extent of a whole lobe. Sometimes they contain more or less of the remains of the softened tubercle, or a more liquid pus, or a mixed serous, mucus, and purulent fluid tinged with blood, or they may be empty. They communicate with the air-tubes, and often with each other,—the process of softening and ulceration having opened the passage; but blood-vessels and interlobular septa are often found to have escaped the destructive process, and form cords or bands across the cavities. The blood-vessels are, however, almost always impervious in these cases, and the septa are thickened by the deposition of lymph. The walls of the cavities are composed of the consolidated tissue of the lung, rough, and sometimes sloughy; or of an irregular coat of lymph; or, in old cavities, of a kind of new membrane, which in some cases is thin and fine like a mucous membrane, and in others thick, rigid, and more of a fibro-cartilaginous character. When these cavities approach to the pleural surface of the lung, there is often a coating of lymph or false membrane on the pleura at the part, which either thickens in it, or unites it by adhesions to the costal pleura. Sometimes, however, there is no such deposit or adhesion; and it occasionally happens that the pleura is also ulcerated, and being perforated, allows the contents of the cavity, and the air from the bronchi, to pass into the pleural sac, causing pneumothorax and pleuretic inflammation. There is this remarkable in the position and size of the cavities,—that they are almost always largest and most numerous near the summits of the lungs; there being often one or more cavities there, when in the inferior lobes there are only scattered indurations. In fact, it may generally be observed of all the lesions connected with phthisis, that they affect the upper and posterior more than the lower and anterior lobes; and that they are more advanced in the former. This is, however, more remarkable with the circumscribed indurations and tubercles; for with the diffused consolidations especially of the light opaque kind (tuberculous infiltration,) the middle and inferior lobes are often also affected, and cavities are commonly found in every part.

Besides these chief and more essential changes of the lungs in phthisis, many others are often found of a more accidental character, such as hæmorrhagic effusion and consolidation; inflammatory congestion and hepatisation of the lung; products of inflammation in the pleura; inflammation, ulceration, thickening, and dilatation of the bronchial tubes; irregular dilatation of the air-cells, sometimes with increased flaccidity, sometimes with rigidity; enlargement and induration of the bronchial glands, with yellow tuberculous matter in its different states in them. The last affection is of common occurrence in children; and, according to Dr. Carswell, sometimes exist to such an extent as to cause the glands to swell and press on the trachea near its bifurcation.

Besides in the lungs, various lesions are frequently found in other organs in the consumptive. The trachea and larynx are not uncommonly ulcerated, particularly in those parts over which the matter expectorated most commonly passes. Hence the side of the trachea and branches next to large cavities in the lungs, and the under surface of the vocal cords and epiglottis, are more commonly the seat of these ulcerations. Louis met with ulceration of the larynx in one-fifth of the cases of phthisis which he examined, and of the trachea in a third; whilst these lesions were met with only once in 122 cases not phthisical. MM. Trousseau and Belloc have also shown that ulceration of the larynx is generally, but not constantly, connected with pulmonary tubercles. The ulcers are very various in number and size, and they do not often extend below the mucous and sub-mucous membranes.

Tuberculous disease is found in other parts besides the lungs, in a large proportion of consumptive cases; the situation of its prevalence varying with the age

of the subject. Thus Papavoine found it, in children especially to occur in the cervical and mesenteric glands, in the spleen, pleura, liver, and small intestines; less frequently in the peritoneum, large intestines; and rarely in other parts. In the consumptive cases above the age of fifteen, examined by Louis, tubercles were found in the small intestines in one-third of the whole; in the mesenteric glands in a fourth; in the large intestines in a ninth; in the cervical glands in a tenth; in the lumbar glands in a twelfth; in the spleen in a fourteenth, of all the cases; and in other parts in smaller proportions. In by far the greater number of cases, the tubercle in these different parts seems to be of more recent date than those in the lungs.

The intestines are very commonly more or less ulcerated in pulmonary consumption. Louis found this lesion in five-sixths of his cases; and in the large intestines, besides ulceration, there were thickening, softening, and increased redness; and out of the whole number which he examined, in three instances only were the large intestines found quite healthy. The liver not uncommonly presents a very peculiar appearance in phthisical subjects. Louis remarked, that in two-thirds of his cases the stomach was remarkably distended, sometimes acquiring double or treble its usual size, and reaching down to the pubis; a condition rarely to be met with in other diseases.

A very remarkable change is often found in the liver of phthisical subjects, caused by the deposition of a kind of fatty matter in its structure. The bulk of the organ is generally increased; it is softer than usual, and of a paler colour, and on being cut greases the knife, or more evidently shows its oily quality on a slice of it being heated on paper. This state of the liver does not occur in all cases of phthisis, and is more common in females than in males: it is found in rapid as much as in prolonged cases. The function of the liver does not seem to be much impaired by this change, for the ducts contain bile as usual.

Pathology of pulmonary tubercle. The characteristic changes which anatomy discovers in the lungs of the consumptive, may for the most part be reduced to two. 1. Consolidation, generally indurated, either almost colourless and semi-transparent, or pearly gray, or reddish drab, or of a dark red or more dingy colour. 2. An opaque yellowish-white or parsnep-coloured friable matter, of various degrees of consistency, being first more or less hard, and afterwards becoming soft and forming vomicæ: this lighter opaque matter, which is properly called tuberculous, is produced commonly within the consolidations just named, but sometimes elsewhere. We proceed to advert shortly to the opinions of some eminent modern pathologists on the nature and origin of these lesions.

Laennec considered tubercles, "accidental productions—that is, real foreign bodies—which spring up in the substance of the lungs, and may be developed in any other texture of the body." We owe great respect to the name of Laennec, but we must in candour confess that his views of the nature and origin of tubercle are neither satisfactory nor altogether intelligible. It may be collected from his writings, that tubercles are parasitical bodies originating in an unknown way, possessing a life and structure of their own, growing by attracting matter to them, and tending by their own inherent properties to go through a certain series of changes. The transparent miliary granulations of Bayle, the gray miliary tubercles, the gray diffused induration, and a kind of gelatinous infiltration, he looked on as varieties of these bodies in their first stage, and as all tending, *per se*, first to become opaque and yellow, or crude tubercle, which is still hard; and afterwards to soften into a cheesy or pasty liquid, which is the mature tubercle. Now this view involves several assumptions little supported by analogy;—for instance, that bodies so different in physical character and texture are the same; and that the stages through which they pass are produced by assumed inherent properties, and not by the modified properties of the tissue of the organ;—and it farther assumes what has been disproved by extended observation,—that the opaque yellow tubercle is always preceded by the gray or semi-transparent, and that the gray induration must always in time become yellow tubercle. Whilst we admit the

accuracy of Laennec's observation, that the gray and semi-transparent indurations tend generally to become yellow tubercle, we must consider his view of the change to be too hypothetical and unsupported to be received as satisfactory.

The view of M. Andral is far more simple, and involves fewer assumptions. He considers tubercles generally to be the result of a modified nutrition of the textures; and that they are produced and go through their changes by the agency of the vessels of the part, and the blood which circulates in them. Although he admits that the miliary and diffused indurations precede the production of yellow tuberculous matter, he supposes them to be not an early stage of this matter, but the result of chronic inflammation affecting the individual vesicles, or the general texture. The chief peculiarity of this view is, the explanation of the regular form and size of miliary tubercles, by locating them in the individual air-vesicles, just as the same author first accounted for the granulations of a hepatised lung. That the diffused induration, called by Laennec the first stage of tubercle, is the result of chronic inflammation, has been admitted by Chomel and Louis, who otherwise rather incline to Laennec's views.

The most recent writer on this subject is Dr. Carswell, who has developed his views in his admirable *Illustrations of the Elementary Forms of Disease*. He neither adopts the opinion that the indurations are an early stage of yellow tubercle, nor does he admit that they are more than accidentally connected with it. He supposes yellow tubercle to be a peculiar secretion, which takes place especially from mucous membranes; but that it may accompany other secretions, such as that of inspissated mucus in the air-vesicles, or of dense false membranes on the pleura or peritoneum; and thus he accounts for the gray miliary bodies with specks of yellow tuberculous matter, and the similar admixture of this matter with deposits on serous membranes. But on minutely examining the miliary granulations of the lungs, we find no *inspissated mucus* in them to account for their hardness; the induration is obviously in the texture itself, and not merely contained within the cells. Dr. Carswell's view, therefore, throws no light on the manner in which yellow tubercle is produced in the gray or dark indurations, whether miliary or diffused; yet this is a point as well established as any in the pathology of phthisis.

It would take more space than we can spare, to enter into farther particulars of the different opinions which have been held in regard to tubercle. If we consider the subject of the pathological changes of the lungs in phthisis, rationally, and in connexion with what we have learnt of those in other textures, and other diseases, we may hope to attain a more consistent and satisfactory view of the subject. The researches and opinions of Professor Alison have led the way in this inquiry, and we are indebted to him for some of the succeeding observations.

If we examine the induration that commonly precedes the production of yellow tubercle, we find that it differs from the healthy structure, certainly in these respects,—that it contains a greatly increased quantity of matter, and that this matter is generally harder than the healthy tissue. Now, this increase of substance implies either increased secretion or diminished absorption: that absorption is not diminished in the tissue, is plain, from the fact that portions of the healthy texture are at the same time removed by this process, around the indurations; and that increased secretion is present, is proved by the fact, that the indurated texture presents new characters, and is not a simple accumulation of the matter of the natural tissue. Now, to produce an increase in the nutritive secretion, there must, according to a well-established pathological law, be an increased determination of blood to the part. Let us now inquire, whether increased determination of blood in other cases leads to the production of matter like that of the indurations; and as the most distinct form of determination of blood, we first take inflammation.

In treating of pleurisy, we found that acute inflammation of the pleura, causes an overflow of the nutritive secretion, in the form of coagulable lymph, which may soon become well organized into a soft cellular or serous membrane; but when

the inflammation is of a lower and more chronic character, the effused matter is slower in the process of organization, and forms a harder texture of lower vitality,—a kind of fibrous or fibro-cartilaginous structure. The same observations will apply to the parenchyma of the lung. The overflow of the nutritive secretion, caused by acute pneumonia, we have found to constitute red hepatisation, whether granular or diffused; but on examining the effect of lower and more prolonged inflammation on the tissue of the lung, we formerly described a dark consolidation with increased density, in no essential particular differing from some forms of the indurations of phthisical lungs. Thus the hard, compact, granular consolidations occurring around excavations, gangrenous as well as tuberculous, and admitted, even by Laennec, to be the result of chronic inflammation, has sometimes the colour and consistence of the indurations which precede the formation of yellow tubercles; and as we have shown that there is a non-granular form of acute hepatisation, so it is reasonable to expect that there may be a uniform or diffused kind of consolidation, resulting from chronic inflammation, affecting the interstitial more than the vesicular tissue. To such a condition, the gray diffused induration, called by Laennec the first stage of tubercle, so exactly answers, that Andral, Chomel, Louis, and Carswell, all concur in considering it a chronic form of hepatisation. When it is the sequel of the acute disease, or of long continued pulmonary congestion, there is often much redness in the induration; but where the irritation has been of long continuance, and unattended with the more sthenic degrees of vascular action, or a very congested state of the lung, the texture is more semi-transparent, dense, and gray, or variously modified by the black pulmonary matter in it. The more uniform or colourless masses occasionally present, may be traced to be the interlobular septa, or cellular tissue around the vessel, in a state of indurated hypertrophy. In these bloodless and almost cartilaginous portions, we see the exact characters of the matter of which the miliary granulations or gray miliary tubercles are minute samples; and if we adopt the view of Andral, that the regular size of these depends on the chronic induration being located in the coats of individual vesicles, we shall see a sufficient reason for their being regular in form, and isolated or in clusters. Moreover, as we have traced the diffused consolidations of the lung through various gradations, from acute soft red hepatisation, down to gray induration, so M. Andral has found the miliary bodies presenting the same gradations, being sometimes soft and red, in other cases, livid and harder, whilst the same lung may contain also the granulations similar in size, but pale or gray, and of different degrees of induration. We have twice met with the more rare transparent miliary granulations of Bayle, on the pleura and peritoneum, in conjunction with dense false membranes, and without any yellow tubercles there or elsewhere. As to the common pale granular deposits on serous membranes, they are the acknowledged products of chronic inflammation, and their numbers and circumscribed form constitute another point of resemblance to the miliary indurations, which in the lung pass into the state of yellow tubercle. Without, then, going so far as to assert that the miliary indurations of the pulmonary tissue are always dependent on chronic inflammation, we may fairly say that both they and the diffused induration are more akin to the products of this process, than to any other that we are acquainted with.

The condition of the blood we found to be a material element in determining the products of inflammation in the case of pleurisy; so, doubtless, it is likewise concerned in the modified putritive secretions of other textures. The more vital and organizable products are furnished by blood rich in fibrin; and they are easily re-absorbed; or if organized, are mobile, and sufficiently like the tissues of the part, not to incommode or irritate them. But if the blood be poor in nutrient matter, the deposit from it may be susceptible of only a low degree of organization, and will consequently be not only more difficult of absorption, but less assimilable to the texture of the part, and more calculated to irritate it as a foreign body. It will thus appear, that although the lowest degrees of inflammation may be alone capable of producing the chronic indurations, when the blood is healthy, yet,

when it is diseased, various degrees of inflammation or congestion—nay, even the ordinary nutrient process, without hyperæmia, may be accompanied by the deposition of a lymph of degraded character, and organizable only into a dense semi-cartilaginous tissue.

The semi-transparent gray or dark induration is always converted into crude yellow tubercle. Sometimes it is the seat of vomicæ which contain a dirty or bloody pus; and, although even in this the curdy matter of tubercle is sometimes seen, it is plain that these vomicæ result from a more distinct and speedy process of ulceration or irregular suppuration; another analogous result of continued irritation in the condensed tissue.

Let us now pursue the same inquiry with regard to the opaque pale yellow matter which characterizes the second class of phthisical lesions. Laennec calls this the second stage of tubercle; but neither for its formation, nor for its subsequent softening, does he assign any other cause than an assumed and unintelligible "inherent property." Dr. Carswell is more explicit on this point; and all his descriptions of tubercle apply only to this kind of matter. He considers it to be a secretion *sui generis*, totally destitute of organization; an effete matter, continually separated from blood in an unhealthy state; thrown out chiefly on the free surface of mucous membranes; and producing bad consequences only in proportion as it accumulates in organs, impedes their functions, and acts on them as foreign matter. This opinion, so far as it relates to the nature of tuberculous matter, does not differ materially from that long since published by M. Andral, who regards tuberculous matter as a peculiar secretion, formed under the influence of a particular diathesis or condition of the blood, and especially in connexion with an irritation, inflammation, or congestion of the blood-vessels of the part.

If we survey the general characters of tuberculous matter, consisting of pale opaque albuminous particles, generally deposited in a tissue previously consolidated, and the manner in which it tends to become liquid, forming circumscribed collections, like abscesses, or infiltrated through the texture, from which it is expelled like foreign matter, we cannot fail to see some general resemblances to the process of suppuration. We have found that the consolidating lymph of a hepatized lung becomes opaque and light-coloured before it softens into pus; but the changes here are too rapid to admit of their being fully watched. But when an analogous process goes on more slowly, and in a simple structure as the pleura, we can better trace the resemblance. Thus, in the latent and more protracted forms of pleurisy, the lymph first effused forms a dense tissue of low vitality, and resembling cartilage in hardness and colour. If the irritation still continue, this new structure throws out a lymph of still lower vitality, in friable shreds, and in some instances in form of a curdy matter, totally incapable of organization, which, mixing with the effused serum, constitutes one kind of empyema. Now such a process in the pulmonary tissue would resemble all the changes which we have been describing in the production successively of the gray induration, crude tubercle, and softened tubercle. Thus a portion of this tissue (whether a single vesicle, or part of a lobe) generally under the influence of chronic inflammation, or local congestion, becomes indurated by the effusion of lymph susceptible of a low organization. The original irritation continuing, or the very induration itself determining an increased flow of blood to the part, the new structure evolves, in the looser parts of its substance, a still less organic form of albuminous matter, a pale, opaque, curdy substance; but as this cannot be (like that from the pleura) thrown off, it presses on its indurated matrix, and, causing its absorption, accumulates in its place: thus is effected the conversion of the gray induration into crude yellow tubercle. This entirely inorganized substance, acting as a foreign body on the adjoining tissues and the remains of the living texture within it, causes irritation, ulceration, and the effusion of serum and pus, which, as M. Lombard first explained, softens and breaks up the crude tubercle into the curdy grumous matter of the mature tubercle. The same irrita-

tion and ulceration gives vent to the matter through one or more bronchial tubes; and thus are formed the tuberculous cavities.

But we have seen that yellow tuberculous matter is produced not only in the gray indurations, whether granular or diffused, but also in softer consolidations like that of hepatisation. It is sometimes seen in rounded circumscribed masses in a hepatised lung; in other instances, it pervades, with its opaque yellowish-gray or mottled colour, a whole consolidated lobe. In this—the *infiltrated tubercle* of Laennec, the *gray hepatisation* of Andral—there are often here and there cavities containing a curdy pus, and communicating with the ulcerated bronchi. There are also occasionally found in it circumscribed indurations and tubercles of older date; but in other instances, no other form of chronic lesion is present, and the lung has the appearance of inflammatory engorgement in some parts, of common red hepatisation in others, whilst other portions of the same consistence have the opaque yellowish colour of tubercle; and these conditions pass by such imperceptible gradations into each other, that it is impossible to avoid the conclusion that they are parts of the same process. We see a similar variety sometimes poured out by the inflamed pleura, where one part is covered with good lymph, another with a curdy matter like crude tubercle, whilst many albuminous particles, also in an unorganizable state, are thrown off with the liquid into the sac. So, also, in the very masses of coagulable lymph that an inflamed pleura or peritoneum throws out, there have been found distinct purulent and tuberculous depositories. Nor is this surprising, when we consider that lymph, pus, and tubercle are the same albuminous matter, and differ from each other in mechanical condition, and susceptibility of organization, rather than in their chemical nature. According to the microscopic researches of Gendrin, part of which we have followed, lymph is composed of regular globules, which by a vital attraction, string themselves into fibres and films, which may become organized and form membranes. Pus consists of larger and less regular globules suspended in serum; but these globules have no vital attraction for each other, and remain loose, and consequently insusceptible of farther organization. Tuberculous matter is wholly devoid of organic form; its particles not even being globular, but irregular, like those of mere dirt or clay; and it must remain where formed, a dead inert mass, until decomposed by chemical agency, or changed by the operation of the surrounding tissues. It is obvious that these different properties, although possessed by matter chemically the same, and from the same source, may lead to all that variety of results which we know to follow organizable, purulent, and tuberculous depositories. But the characters of these matters are not always distinct; lymph is not always equally organizable; nor is it always free from the greenish colour and less coherent globularity of pus, nor even from the lifeless curdy particles of tubercle; and tuberculous matter often contains flakes or films of imperfect lymph. The diffused tuberculation or infiltration of the lung from inflammation, lately noticed, generally presents matter in this transition state. It is neither good organizable lymph, nor wholly unorganized tubercle; and the albuminous effusions on serous and mucous surfaces not unfrequently present such an intermediate state, that it is difficult to determine to which class they belong.

But, lastly, we have found that tuberculous matter is sometimes deposited in tissues bearing no marks of inflammation or other disease. The structures thus affected are commonly those either very vascular naturally, or peculiarly liable to congestion of blood; and viewing tuberculous matter as a deposit of unhealthy fibrin from the blood, we see a reason, as Dr. Carswell observes, why it is most likely to be found in those organs where the blood accumulates or passes slowly. Whatever be the cause which in these cases determines the deposit of tubercle, we know that pus also is sometimes secreted in parts unaffected with inflammation, as in the purulent depositories in the viscera after injuries or surgical operations; and in the profuse purulent discharges from the bronchial membrane,

where it is found after death free from all trace of inflammation; nay, something like pus has been found in the blood and in the centre of fibrinous coagula in the heart, when no suppurating surface existed in the body: so, likewise, tuberculous matter has been met with in coagula in the heart, spleen, and blood-vessels. This tends to show that the fibrin of the blood is liable to be converted into tubercle independently of any action of the vessels; it loses its vitality, and may in proportion be merely deposited in tissues or on surfaces, independently of irritation. Here, again, as with the gray indurations, we are led to trace to the condition of the blood one cause of consumptive disease of the lung; and it is probably a diseased state of this fluid that constitutes what is called the tuberculous or scrofulous diathesis, in which there is a tendency, by vessels in different degrees of activity, to deposit tubercle instead of lymph; and when this diseased state exists to a great extent, the tuberculous matter is excreted from the blood without any increased vascular action, and merely as an accompaniment of the natural secretion of a membrane, or instead of the ordinary nutriment deposit of a tissue. Whatever, in such cases, determines the first deposition of tubercle in a tissue, will with greater facility effect its increase, by the addition of similar matter to a ready-formed nucleus. The tendency to the deposit of yellow tubercle independently of irritation, implies a condition of the blood even more depraved than that which leads, under the same circumstances, to the formation of the chronic indurations; it is an ulterior degradation of the fibrinous nutriment of the tissues, replacing them by a matter not merely inapt in texture, and of lower vitality, but wholly destitute of life, the principle of organization. When, therefore, tuberculous matter is found in an uninflamed tissue, it may be regarded as a sign of the most decided constitutional taint. In such conditions of the system, tuberculous depositions may take place with great rapidity; and as they are already almost ripe for elimination, the ulceration and destruction of the lung will soon follow. But nothing can give development to the tuberculous disease with such fearful rapidity, as the occurrence of acute inflammation in the pulmonary tissue. It is, we believe, from this process in a highly tuberculous constitution, that the general tuberculous consolidation, called infiltrated tubercle, takes place. The matter deposited is often a mixture, or intermediate state of lymph and tubercle, one product predominating in some parts, and the other elsewhere; but it is altogether beyond the reach of the sorbefacient remedies, which avail in pneumonia to promote the absorption of simple lymph; and if it do not destroy life by its solid interference with the function of the lung, it speedily runs in many points into softening and suppuration, and the patient is carried off by a *galloping* consumption. In this case the lungs are found extensively solidified, and, on incision, incipient cavities are seen almost in every part; but there is no induration; the most solid parts have scarcely more substance than a hepatised lung, and they even more readily break down under the fingers.

The development of the indurations is a work of more time; and their structure makes the destructive process which they induce more tardy; nay, the diffused indurations which form the walls of softened tubercles and vomicae seem to be a provision of nature against the spread of the consuming disease; but under certain circumstances, even the indurations are formed to such an extent and so soon, that the patient is destroyed by their first development, or rather by the effusion of mucus or of serum which they excite. In most cases, the first formation of granulations is not sufficient to prove fatal; but as some of these are becoming changed to tubercle and vomicae, another deposition or crop of them (as Laennec terms it) takes place and causes suffocation.

After what has been stated, it will hardly be necessary to discuss the question of the seat of the hard gray and the yellow tuberculous deposition. If the tubercle be, as we suppose, a degraded condition of the fibrin or nutrient principle of the blood, we may expect it to be deposited wherever the nutritive or the secreting process is carried on, wherever lymph or pus is occasionally found,—wherever,

in short, blood-vessels run. We cannot assent to the opinion of Dr. Carswell, that tuberculous matter is in the early stage of the disease secreted in equal abundance from all parts of the mucous membrane, and that the only reason why it accumulates sooner and more in the upper lobes is, that their smaller extent of motion prevents its perfect elimination from those parts; were this the true view, how easy would be the diagnosis of consumption in its earliest stage! For there would be abundant expectoration of tuberculous matter from the lower lobes, whilst the accumulation takes place in the upper; yet it is rare to see any expectoration in the earliest stage, except a thin transparent mucus. More probable is the opinion of Broussais, that the upper lobes are the first and most extensive seat of tuberculous change, because the bronchial tubes are shorter, and more readily permit inflammation and irritation to pass to the cells. But we apprehend that the real reason of their peculiar liability is in the greater abundance of interstitial tissue in them. The bronchi, instead of being lengthened out into mere membranous tubes before they terminate in cells, divide more immediately and abruptly into short branches and cells; and the delicate vesicular structure is thus mixed up with a good deal of the interstitial cellular tissue that every where surrounds the earlier bronchial divisions. The smaller capability of motion possessed by the upper lobes of the lungs may, too, have a share in disposing them to become the seat of tubercular deposit, not by permitting it to accumulate, but by favouring bronchial obstructions to the respiration, and causing local congestions of blood, which may promote the formation of tubercles. It is not the yellow tubercle chiefly that predominates in the upper parts of the lung; it is rather the gray indurations which become afterwards converted into yellow tubercle. Primary tuberculous deposits are nearly as common in other parts of the lung as at the apex.

We have described the ordinary changes of tubercle from its primary deposition to its softening and evacuation, and the formation of an ulcerous cavern. These caverns become, if life last, lined with a deposit of a mixed nature, but with an albuminous lymph for its basis; and this is commonly mingled with tuberculous and purulent matter. Hence it seldom lasts long, but is broken up, detached, and expectorated. When the constitutional powers are stronger, and the lung less extensively diseased, the coating of the cavity is susceptible of organization, and in time forms a fibrous or fibro-cartilaginous membrane which pretty smoothly lines the cavity. If the cavity communicate pretty freely with the bronchi, it will be kept by the pressure of the air from any considerable contraction to which it naturally tends: but in some instances the tubes become obstructed, and the membrane contracts, and tends to obliterate the cavity, sometimes leaving only a cicatrix. Such contracted cavities and cicatrices are not unfrequently met with in the lungs of old people; but they are rarely quite empty; they contain more or less of a pale yellow plaster-like matter, consisting chiefly of carbonate and phosphate of lime; and sometimes there are concretions of the same matter. The contraction is evident from the puckering of the pulmonary tissue visible on the pleural surface near the cavity, and some of the adjoining vesicles are generally dilated to fill up the space. There are often, also, some remains of gray induration around them. The cretaceous matter is probably secreted by the walls of the cavity; but it may be the debris of tuberculous or purulent matter, the animal matter being absorbed away, and the earthy insoluble salts left, accumulated from successive depositions. This earthy matter is sometimes connected with an earlier stage of tuberculous formation. We have, in lungs not extensively diseased, found pale yellowish tubercles, composed of concentric layers of almost cartilaginous hardness; in another part of the same lung, these layers are loosened by a plaster-like gritty matter of a calcareous nature; and in another part a whole tubercle may consist of this, having only a few flakes of albuminous matter in it, and sometimes containing concretions. This more resembles what is commonly called the atheromatous structure, which especially invades the coats of the arteries and the fibrous parts of the valves of the heart. It is to be classed with gray and yellow tubercle, in so far as it is another variety

of matter, low in the scale of organization, and formed of lymph of defective vitality. In these latter cases there is no puckering or contraction about the tubercle until it has evacuated its contents; which it is very slow to do; for it has not the tendency to soften and cause ulceration that makes common scrofulous tubercle so destructive. We have repeatedly seen a few of these tubercles in lungs otherwise healthy, the individuals having died of some other disease.

Symptoms. As we have made the anatomical and pathological changes of phthisis the basis of our description of this disease, it will be convenient and instructive to classify, as far as we can, the symptoms, in reference to these changes. The course of consumption is generally divided into three stages, according to the state of the lesions of the lungs. The *first stage* is that of the formation of the indurations, granular or diffused; the *second* is that of the conversion of these into yellow tubercle, with the extension of this lesion to other parts; the *third* is that of their softening and evacuation, and the formation of vomicae.

First stage. The symptoms produced by the indurations may be divided into those of irritation, and those of obstruction.

The indurations are generally accompanied by various irritations, both local and general. Of the local irritations, the earliest is cough, which at first is generally slight and merely hacking, but more or less constant; at least, although it may not be frequent, it does not cease for a whole day together. It is either dry, or accompanied by a thin transparent expectoration. Another occasional sign of local irritation is pain in the chest, commonly referred to the sternum: in some instances it is a stitch in the side; sometimes it is a soreness, or an unusual sensibility to cold or exertion, more than actual pain; not unfrequently it is absent. These varieties of pain are sometimes merely irritations; but not unfrequently they are the result of real local inflammation, excited in the lungs, the bronchi, or the pleura, by the indurations. Of the more general irritations, quickness of the pulse is the most constant; but even this is not universal. The quickness is often not uniform at first, but depends on any cause of excitement, however trifling; and the pulse may be very slow and weak in the intervals: but as the organic lesion increases, it gradually becomes more constant, and is accompanied by an irritated state of other functions;—a general febrile state. But even then there is not power enough in the circulation to maintain a general or constantly increased heat; it is manifested most towards night, after the accumulated excitements of the day, when the fulness as well as the frequency of the pulse increases, and there is a flushing of the face and heat in the palms of the hands and soles of the feet, where the thickness and hardness of the cuticle prevent the perspiration and evaporation which moderate the temperature of other parts. Like other weak and intermittent febrile movements, this generally terminates by perspiration more or less profuse, which, occurring in the night, leaves the pulse lowered, but the frame weakened and exhausted in the morning. It is only in the severe cases that this general irritation, or hectic fever, as it is termed, becomes marked at this early stage of the disease. Often there is gastric irritation, with a white tongue, red at the edges, thirst, costive bowels, and turbid urine. These symptoms are generally more remarkable in this than in the after stages, when the irritation is more confined to the organs of circulation and respiration. They are almost always attended by some diminution of flesh and strength, which, however, varies greatly in degree in different instances.

The symptoms from obstruction comprehend those from obstructions to the passage of the air, to that of the blood, and to the motions of the lungs in respiration. The indurations, granular and diffused, when extensive, by obstructing the passage of air to more or fewer of the air-cells, cause the shortness of breath, felt at first only on exertion, so common even in the early stage of consumption. Nay, cases happen, in which an abundant formation of miliary tubercles, together with the œdema, or bronchorrhœa, which they excite, prove fatal in the first stage, by the obstruction which they cause to the passage of the air. In such cases there is generally considerable fever, with short frequent cough, very quick

pulse, and heat of skin, with other symptoms resembling an acute attack of bronchitis or pneumonia; for which they may be mistaken, but for the less sustained character of the fever, the greater permanency of the disorder of the respiratory organs, the physical signs, and the expectoration, which, instead of exhibiting the peculiar aspect of that of pneumonia, or the successive changes of that of bronchitis, continues mucous and frothy, sometimes abundant, but often in small proportion to the cough and dyspnœa. Partial indurations sometimes cause shortness of breath, not only by their direct impediment, but also by occasioning a dilatation of the air-cells.

The indurations, by obstructing the blood-vessels, give rise to many formidable pathological effects. They may thus cause sanguineous congestion, hæmorrhage, inflammation, œdema, gangrene, and atrophy of the pulmonary texture, hæmoptysis, profuse bronchial secretion, effusion into the pleura, disease of the heart, &c.; and the symptoms which these lesions produce may be variously grouped in the history of different cases of phthisis. The hæmoptysis occurring in the early stages of phthisis is generally from this cause; and it is a serious symptom, not only because it may endanger life by loss of blood or direct suffocation, but also because it is often accompanied by hæmorrhagic consolidation and rupture of the texture of the lung, which tend to accelerate the disorganizing process, and promote the farther deposition of tubercle. In some instances, however, hæmoptysis is followed by decided relief to the dyspnœa and cough, having removed a congested state of the blood-vessels.

Obstruction to the motion of the lungs may be caused by the same circumstances which impede the free admission of air to them; but in case of extensive solid deposition, it may also result from their mechanical resistance to the motions of the chest; and this not only constitutes a phthisical sign, which we shall hereafter consider, but it also keeps the intervening unaffected tissue in a fixed state, liable to constant congestion and farther deposit, and thus adds farther to the incapacity of the organs. When once the integrity of a nicely adjusted apparatus like that of respiration is extensively injured, disorder begets disorder, and unless the counteracting or respiratory powers soon come into operation, unless the indurations are soon diminished, or the blood-vessels closed, the whole of that part of the lung may soon become a solid mass. Thus, we believe, sometimes arise those extensive masses of induration which are so commonly met with in the upper parts of the lung.

Second stage. On the conversion of the gray or dark red indurations into crude yellow tubercle, and during the original deposition of this matter, besides the symptoms of irritation and obstruction, which still continue, there are indications of increasing cachexia, languor, loss of flesh and strength, and a general depression of the functions. The pulse loses strength, although it is as frequent as before; the evening chills are more severe; the fever is of shorter duration; the sweats are more profuse. Except at times of excitement, the colour of the cheek fades, or is reduced to a circumscribed hectic patch: the expectoration becomes more abundant, or less thin and transparent, and particles of curdy or cheesy matter can sometimes be detected in it; occasionally it is streaked with blood; and in a few cases there may be hæmoptysis to a considerable extent. There is often less feeling of oppression or pain in the chest than before, but the shortness of breath on exertion is undiminished, if not increased; and there are frequently transient pains in the shoulder or under the clavicle of one side, which the patient commonly considers to be rheumatic.

Third stage. The more truly consumptive symptoms which had begun to manifest themselves in the second stage, are developed fully when the tubercles become soft, partially or entirely liquid, and are evacuated, by the aid of the secretion and ulceration of the adjoining textures. Then comes on, in addition to the symptoms before described, a copious and heterogeneous expectoration of pus, mucus, softened and occasionally solid tubercle, blood, shreds of lymph, and rarely portions of pulmonary tissue in a sloughy fetid state. Then occur the usual

constitutional concomitants of extensive unhealthy suppurating ulcers, confirmed hectic with its successive chills, heats, and sweating, occasionally diarrhœa, and the increasing marasmus, in this case rendered more pronounced by the importance of the organ affected and the relations which it bears to the process of sanguification. Then are the dyspnœa and cough increased by the continual discharge of matter into the air-passages, and by the extension of the diseased depositions and ulcerations of the tissue. Yet it is a curious circumstance, that these symptoms are often inconsiderable in proportion to the terrible extent of the organic mischief which has been produced; the dyspnœa often is not painful like that of asthma; it is a state of breathlessness rather than of distressing oppression; the cough is commonly less violent than in chronic bronchitis; the pain may be slight, or there may be none at all; the countenance, though thinned, tremulous, with the sharpened nostrils, habitually moving at every breath, may have a clearness in it, with colour in the lips, and a brightness of the eye which are never seen in other serious diseases; and the frame of mind is often in the same unconscious and hopeful state, indicating a degree of freedom from those painful struggles in which the vital powers commonly contend with other serious disorders. Now, we apprehend the chief reason for this exemption from suffering lies in a sort of balance that is maintained among the injured functions. The available parts of the lungs are reduced to a great extent; but so is the mass of blood that has to pass through them. The free expectoration and the colligative discharges from the skin and bowels are continually bringing down the bulk of the circulating fluids to the lessening capacity of the remaining lung. The night sweats, especially, are a periodic discharge of the amount of fluid which is beyond what the reduced system of blood-vessels can quietly hold; they often cease when the fluid ingesta are judiciously reduced. So the secondary pulmonary irritations, congestions, and inflammations are continually relieved by the purulent expectoration; it is a safety valve which gives vent to these local lesions before they cause much distress; and although the destructive process is perpetually proceeding, the lungs decaying, the body wasting, and the strength failing, yet it is all by even degrees, a *fecilis descensus*: the thread of life dwindles away, fibre by fibre, without struggle or shock; and gentle is the parting of the last filament, when the body drops to earth and the soul rises to eternity.

But the progress of consumptive disease is by no means generally thus painless and unharassed: the sufferings from dyspnœa, cough, pain, chills, heat, and feelings of extreme weakness and faintness, are sometimes very severe. In some persons, the animal sensibility is more acute than the organic life is active; to such, any disorder is distressing; and even in consumption, the cough, the pains in the chest, side, or shoulders, the alternate chills and heats, the oppression of dyspnœa, the languor and faintness of debility, besides various pains and aches in different parts of the body, are perpetual sources of complaint. But without any unusual sensibility in the subject, the course of consumptive disease may be rendered rough and painful by what may be called the accidental or accessory lesions, contingent upon it. Intercurrent congestions, hemorrhages, and inflammations taking place in the lungs or in their investing membranes, are very common, and may give rise to the symptoms of these several acute lesions superadded to those of phthisis. Hence the increase of cough, dyspnœa, and fever, occasionally with pain, in case of bronchitis, pneumonia, or pleurisy, occurring in the course of the disease; and hæmoptysis, with the faintness and other effects of loss of blood, if this be considerable, or with greatly increased oppression if the effusion is more confined to the tissue of lungs. We can confirm the observation of Dr. Stokes, that free expectoration tends to prevent these accidental complications; and accordingly their occurrence is often preceded or accompanied by a suppression of this discharge, or an alteration in its quantity. But there is an accident which especially tends to ruffle and hasten the course even of the most latent forms of consumptive disease; this is perforation of the pleura, and the consequent pneumothorax and acute pleurisy which it produces. As we have already described this

lesion and its symptoms, we need here only remark how characteristic the sudden increase of dyspnœa and cough and accession of sharp pleuritic pain must be in the cases that were before most insidious, and how much the addition of these lesions must increase the distress of the patient, and hurry him towards his grave. Spontaneous perforation of the pleura seems to occur chiefly where the constitution is decidedly tuberculous; and it implies a want of that self-preserving energy by which the mischief of ulceration is bounded by the timely effusion of plastic lymph. This is a part of the nutrient function; and perhaps it is because this function is more active in women than in men, that perforation of the lung is comparatively rare in females. Such, at least, is the result of our experience, not having met with one instance in about thirty cases of this complicated lesion that have fallen under our observation; and there are very few instances recorded by others of its occurrence in females. In a few instances, the perforation appears to have been the result of adhesions partially attaching the lung to the walls of the chest, and thus exposing it, in case of external violence or internal pressure, to a lacerating force, as noticed under the head of pneumothorax.

Other symptoms unconnected with the chest frequently attend pulmonary consumption. The larynx is very often the seat of disease, and hoarseness or loss of voice is frequently an early symptom, sometimes taking attention from the seat of the more important lesion. It appears from the researches of MM. Trousseau and Belloc, that ulceration and other structural disease of the larynx do sometimes occur when there are no tubercles in the lungs; but these are very rare cases, and in by far the majority of instances these lesions are associated with tuberculous disease of the lungs, and perhaps in all are connected with a tuberculous constitution. Dr. Stokes considers this complication to be universally fatal; but it is not always speedily so, for we know at present three instances in persons now alive of its having lasted from five to eight years.

The disorder of the digestive organs, which, in the earliest and irritative stage of the disease, had something of the gastritic character, with red-tipped tongue, thirst, sometimes pain or oppression after eating, occasionally tenderness of the epigastrium and other symptoms of indigestion, generally passes away as the pulmonary irritation is relieved by the discharge. In a few instances, occasional severe pain of the stomach, and vomiting, continue to the fatal termination, greatly adding to the distress and weakness of the patient. In most instances, sooner or later, the bowels become disordered; constipation and diarrhœa alternately prevail, dependent on inflammation and ulceration, often complicated with tuberculous deposition in the follicular structure of the mucous membrane of the intestines. The mesenteric glands frequently become involved in the same disease, particularly in young subjects; and thus arise additional causes of exhaustion and atrophy, in the colliquative discharges and obstruction to nutrition that ensue. There is often but little pain with all these serious lesions. The alvine secretions sometimes show a deficiency of bile; but this is a symptom which more frequently precedes phthisis than accompanies it. Sometimes there are great tenderness and even pain in the abdomen during the whole course of the disease, with occasional exacerbations; these symptoms generally depend on granular or tuberculous depositions on the peritoneum, combined occasionally with inflammation of the membrane, which may lead to the agglutination together of the folds of the intestines.

More rarely tubercles occur in the brain or spinal marrow, or their membranes, and cause symptoms of mental disorder, convulsions, or paralysis. Acute hydrocephalus seems to have connexion with scrofulous or tuberculous disease farther than what can be traced to the existence of tubercles in the encephalon; for it sometimes coexists with tuberculous disease in other parts, when none can be detected in the brain. The catamenia, in females, are generally defective, or absent, at an early stage of consumptive disease; but they are not so constantly so as Laennec supposed. Their suppression is, on many accounts, an unfavourable sign. We have not space to dwell on the details of other symptoms arising from the irritations or obstructions, the weakness or the wasting, which tuberculous consump-

tion brings in its train. The emaciation in the last stages is very great, especially in the less acute cases; yet it is surpassed by that from scirrhus of the stomach, and tabes mesenterica. There is a blanching with emaciation, which is more remarkable than its degree; the blood-vessels are reduced, as well as other textures; hence it is rare in tuberculous consumption to see the redness of the knuckles, and distinctness of the veins of the hands, which accompany even greater degrees of emaciation from chronic diseases of the abdomen.

Physical signs. We proceed to trace the physical signs in the different stages of the textural lesions which we have described as the essential causes of pulmonary consumption.

First stage. In proportion as the indurations which characterize the first stage are of great or small amount, and are concentrated within a small space, or scattered widely through the lung, they will produce more or less appreciable signs. Thus, the miliary indurations, even in considerable number, may be scattered through the tissue of the lung without producing any distinct diminution or change in the respiratory sound, or in the resonance of the chest on percussion. Sometimes there is a general sub-mucous or sub-crepitant rhonchus; but this proceeds less from the tubercles than from the secretion which their irritation causes in the bronchial tubes: it is the sign of a partial bronchitis or bronchorrhœa, therefore, and can be taken in evidence of the probable presence of tubercles, only when it continues permanently, or recurs in the same places day after day, instead of tending to become sibilant, and to cease, as the rhonchi of common bronchitis do. But it seldom happens that even the early indurations are equally scattered through both lungs. Their tendency is to accumulate in greater numbers in little clusters near the apices of the lungs, and generally more on one side than on the other. Here there will be a concentration of their effect, and an inequality between the two sides of the chest; and on exploring the corresponding regions outside, which are the clavicles and the space below them, and the upper ridge of the scapulæ, we may find differences in the sound on percussion, or those of respiration, and the voice, which, according to known principles, may be interpreted as signs. The clavicle on one side, when lightly struck downwards on its centre, yields a sound duller than that on the other; and especially if this difference extends to the other parts just mentioned, it is exceedingly probable that there is consolidation of the lung in that part. Great care must be taken to strike both clavicles at the same point, or both infra-clavian spaces in the same mode, or the comparison will not be a fair one. To avoid error, the parts should be quite uncovered; and various kinds of percussion should be tried in doubtful cases, as tapping with a single finger, and with the flat of several fingers, and in different stages of the respiratory act, on a full breath, and after exhausting the lungs. Sometimes the gentlest possible patting of the sub-clavian spaces is the only mode in which any difference can be discovered. In the posterior region, and on the scapular ridge, strong mediate percussion with the finger is necessary to elicit any sound, comparison being made, as usual, of the sounds on the two sides. Differences in the sounds are to be sought where differences ought not to exist; and although the mode and force of percussion should be varied at different times, they should be carefully the same in each act of comparison. Between the scapulæ is not an unfrequent seat of dulness, especially in children, where the disease occupies the bronchial glands.

The eyes should likewise be used to scrutinize the motions of the chest, when the patient is placed in a good light opposite to the observer, and is desired to take a full breath several times. It requires more consolidation than is common in the more doubtful stages of the disease, to produce any considerable irregularity in the shape or motions of the chest; but we can often perceive a slight difference between the two sides; the upper ribs do not move quite so much on one side as on the other.

The stethoscopic signs are more delicate, and, perhaps, more equivocal, than those of percussion. The indurations may form slight partial obstructions to the

passage of air, and thus cause a permanent slight wheezing, whistling, or roughness in the respiratory sound, not removed by full inspiration or cough. If more numerous or extensive, they may transmit the sound of whiffing or bronchial breathing in parts where naturally the vesicular only is heard, whilst the soft vesicular breathing is impaired in its force. The sound of expiration may become unusually audible, so as nearly or quite to equal that of the inspiration, which naturally is almost the only sound heard in pure vesicular respiration. When, as it often happens, the partial indurations are accompanied by a dilated or emphysematous state of the neighbouring air-cells, the sound of percussion will be less changed than usual; but the breathing will be more whiffing, or more obscure, according as the dilated cells are more flaccid or more rigid than usual. The sound of the voice is transmitted by the indurations in an unusual degree; sometimes only in a diffused resonance; sometimes in a more circumscribed vocal note, but without the articulation of the oral voice. So, also, below the clavicles, the sounds are sometimes transmitted with unusual clearness from the subjacent arteries, being either double from those of the heart, or single from the mere impulse; and occasionally the single pulse is accompanied by a whizzing or blowing confined to the part, which, probably, indicates a partial obstruction of the sub-clavian arteries by the pressure of indurations at the apex of the lung. This has been noticed by Dr. Stokes as a sign of incipient phthisis. It is not to be depended on, as such a murmur is not uncommonly induced in some healthy subjects under slight excitement, probably from the artery pressing on the clavicle or upper rib. It often intermits, being confined to certain stages of the respiratory movements.

All the stethoscopic signs derive their importance directly from the situation in which they are heard, and from their comparison with the sounds of other parts. There are often natural bronchophony and bronchial respiration near the sternum, between the scapulæ, and in the axillæ: such signs in these parts, therefore, are not to be considered morbid, unless they be either much more distinct on one side than on the other, or accompanied by dullness on percussion. They may be better trusted towards the humeral end of the clavicle: the angle formed by this bone and the shoulder is the proper stethoscopic corner, and the signs heard there, and at the humeral portion of the scapular ridge, are the most unequivocal; but even here a permanent discrepancy between the two sides gives the surest indication of disease, for the natural sounds present some variety. It is also necessary to bear in mind that the vocal resonance is often slightly louder on the right than on the left side. In the early stage of numerous diffused granulations, there is sometimes dullness on percussion with obscure or sub-mucous respiration in the lower dorsal regions of the chest, probably dependent on congestion of the pulmonary plexus of vessels in these parts.

Besides the more direct physical signs of the indurations, the mucous or sub-mucous rhonchus caused by the secretion of the bronchial tubes, may render their existence probable when it continues long, or returns frequently to the same part. This observation was first made by Dr. Stokes, who has well remarked that this symptomatic bronchitis differs from simple bronchitis in being first circumscribed and confined to the upper lobes, whence it may spread downwards; but before it reaches the middle and lower lobes, the common seat of ordinary bronchitis, the tubercles in the upper become manifest by various obvious signs.

The diagnosis of the early stage of phthisis is often a matter of extreme difficulty; depending, as it does, on a proper consideration of the general symptoms, as well as on a careful examination and interpretation of the physical signs, it cannot be mastered without considerable experience as well as tact on the part of the observer.

Second stage. The conversion of the semi-transparent, gray, or dark consolidation of the lung into yellow tubercle is a point only deduced from anatomical examinations, for there are no certain signs of this change during life. There is sometimes an abatement of the more irritative symptoms during this change,

and at the same time an increased expectoration, and the sub-mucous and mucous rhonchi become more marked. But the change to yellow tubercle can scarcely take place without some augmentation of the consolidation; the indurations increase in extent, and some yellow tubercle is sometimes deposited in other parts. Hence there is often a fuller development of the signs of an increased density of the lung; the partial dullness on percussion becomes more marked; the respiration becomes more obscure or more bronchial, and it may be accompanied by a permanent fine crepitation. The vocal resonance may also increase in degree and extent, and altogether the signs become more localized, and therefore less equivocal. These, taken with the change in the general symptoms before described, may be taken in evidence that the consolidations have become more or less tuberculous.

Third stage. But the softening and evacuation of tuberculous matter, produce the most remarkable and cognizable changes in the physical signs; and these also often give to the expectoration something of the precision of a physical sign. The sputa before may have been sometimes opaque and muco-purulent, as in bronchitis; but they now become decidedly purulent, often sink in water, and, if narrowly examined, may sometimes be found to contain particles of a curdy or clotted matter, like cheese softened in water, which is tuberculous; it is not fœtid like the similar concretions from the tonsils. There may also be little streaks or even clots of blood; but this is uncertain. There is generally, besides, more or less mucus, which gives tenacity to parts of the expectorated matter; but on close examination, it may often be seen that some sputa are opaque purulent clots, almost without mucus; it is these which come directly from the cavities. In whatever part of the chest these changes take place, generally under one of the clavicles, or above the spine of one of the scapulæ, there may be heard a clicking or bubbling sound, which is coarser, and gives the idea of being produced in a larger space than any of the common sounds of these parts. This sign is the more conclusive, the finer and more completely vesicular is the natural structure of the lung in the part in which it is best heard. In listening for it the patient should be desired to cough or to take a full inspiration; when at first there may be heard only one or two clicks from the entry of single bubbles: but as the evacuation of the softened matter proceeds, and there is more room for the entrance of air, there is then a more continued bubbling or gurgling sound, and this will be coarse and distinct in proportion to the extent of the vomica and its communication with the air-tubes. This gurgling or *cavernous rhonchus* will also somewhat vary according to the quantity and liquidity of the contents of the cavity, becoming less crackling and more whiffing as these diminish. When it is heard over an extended space, there are probably several cavities communicating with each other, and all containing more or less liquid. It may present other varieties, which are quite intelligible when the mode of its production is known.

The softening and evacuation of the vomica being complete or nearly so, there is left an ulcerous cavity or cavern, which becomes the seat of farther phenomena. Even before all the liquid is evacuated, we sometimes hear in the corresponding part of the chest, with the gurgling, a hollow whiffing or blowing sound; and when the patient speaks, a sort of *snuffling* voice interrupted, broken up by the gurgling. When the cavern is empty, these pass into *cavernous respiration* and *pectoriloquy*. Cavernous respiration resembles that heard on listening with the stethoscope to the front of the neck over the windpipe; but it is more circumscribed, and does not give the same impression of a rush of air. It may better be imitated by blowing into shells or thimbles of different sizes. It may present considerable variety, according to the size and shape of the cavity, and the freedom with which the air passes into and out of it from the bronchi. When of very large extent, the sound becomes amphoric, like that produced by blowing into an empty phial, and precisely on the same principle. All these phenomena are best obtained with quick forcible respiration or slight coughing, which increases the force and velocity of the passing air, and exaggerates the sounds.

Pectoriloquy is another very striking sign of a cavity in the lungs. Its value was perhaps over-rated by Laennec; but we think that it has neither been appreciated nor understood by subsequent writers. We formerly explained that the voice, although formed in the larynx, vibrates in full strength, through the windpipe and its branches, until it becomes broken up and muffled in the smaller tubes and soft porous tissue of the lung. But if a cavity be formed in this parenchyma, communicating freely with the tubes in which the voice is strong, it will form a part of those tubes, and the vibrations will be continued *in system* from them to it; and there may thus be heard near the surface of the lung, a voice from the chest like that heard over the trachea,—its distinctness and intensity being more or less perfect, according as the cavity is adapted to receive the vocal resonance from the tubes, and to transmit it to the walls of the chest. Laennec made an artificial distinction between the degrees of pectoriloquy, according to whether the voice does or does not give to the ear the impression of passing up the stethoscope when the stopper is in. In the *perfect* kind the words are so distinct that it seems as if the patient had his mouth to the tube: where this impression is not produced, the pectoriloquy is *imperfect*. But this is only a difference of degree, and of doubtful importance. We consider the character of the sound and its circumscribed position a more serviceable distinction. The sound is not a mere vocal resonance, like the bronchophony from consolidation, which is often as loud or louder, and may seem to pass up the tube quite as much; but it is an articulate although indistinct speaking, and sometimes accompanies a loud whisper as well as vocal utterance. There is in it another feature which is characteristic, and distinguishes it from bronchophony; it is accompanied or followed either by whiffs of cavernous respiration, which give the pectoriloquy a snuffling character, or by a hollow or fistular resonance, like that produced on speaking at the orifice of the tube of a Pan-pipe, the pipe of a large key, a shell, or any such hollow body. This accompaniment is sometimes heard when the pectoriloquy or the transmission of the articulate voice is very imperfect; but we have found it to be more distinctive of a cavity than the loudest vocal sound without it. It may be supposed to depend on the same physical cause as that of the similar sound in the hollow bodies to which we have compared it; the cavity in the lungs being in the same relation to the bronchial voice, as they are to the oral voice. When the cavity is large, the resonance is more amphoric or bottle-like; and if the communication with the bronchi be at the same time narrow, the voice may be scarcely transmitted to it, but excites in it only a tinkling echo—a metallic tinkling, as in pneumothorax. All these hollow, fistular, or tinkling characters may be also perceived in the breathing and cough, especially in the latter, but not in a proportionate degree, and sometimes are only perceptible with the voice. These differences must depend on the relations of the cavity to the air-tubes communicating with it: if this open into them so as to catch the current of air passing through them, its interior will be thrown into vibrations; otherwise the air in the cavity may only receive the stronger and more pervading vibrations of the voice. So, also, if there be much consolidation about and beyond the cavity, there may be very little passage of air in the tubes, and therefore but little cavernous breathing.

The circumscription of pectoriloquy is another of its peculiar characters, and by this it may generally be distinguished from the loud bronchophony of condensed lungs, which is diffused over some extent of surface. To observe this difference, it is necessary to limit the point of examination, by using the stopper in the stethoscope. By this mode we can trace the precise boundaries of the pectoriloquy of a cavity; but when we try to trace where the resonance of the bronchophony ceases, we find no exact limits; it gradually loses force as the tubes become smaller, or the super-jacent lung more porous. Pectoriloquy is most characteristic when it forms a *little island* of voice under a clavicle, and little or no sound is transmitted nearer the sternum. The pectoriloquous bronchophony of a lung consolidated by inflammation, or compressed against the walls of the chest by a liquid effusion, never has this isolated character, but is generally louder in proportion to

the size of the tubes involved in the condensation. It is however true, that sometimes the pectoriloquy of phthisis is not circumscribed; for besides the cavities there may be extensive consolidation of the lung, and consequently free transmission of the voice over an extent of surface. Even in this case a practised auscultator can distinguish the peculiar phenomena of cavities, in the snuffling, blowing or tinkling, and the more articulate voice that certain spots present, or in a coarser gurgling if there be liquid. It is obvious that all these phenomena are liable to be interrupted or modified by the accumulation of the matter secreted by the cavities and adjoining tubes; and that, after cough and expectoration, a spot that before gave no sound in common breathing, and gurgling on forced breathing, yields the cavernous breathing and pectoriloquy. So, also, as in time the disease advances, the excavations become extended, and the gurgling first, and the pectoriloquy afterwards, are heard in new spots.

Although, after the excavation of tubercles, there is more air in the chest, yet the sound on percussion generally remains dull, for there is much solid deposit about the walls of the cavities, and the irregular density and flaccidity of the parts, as well as the defect of air in the peripheral structure of the lung, still tend to check and to muffle the vibrations of the walls of the chest, and prevent them from yielding a clear sound. Even where the cavity is so large as to be the seat of a tinkling echo, the resonance on percussion is irregular and imperfect; and thus may this case of metallic tinkling be distinguished from that of pneumothorax, in which some part of the chest must have an unnaturally clear sound. Sometimes the percussion is clearer in consequence of a general dilatation of the superficial cells; and as this is commonly of the flaccid kind, it may be accompanied by a sharp puerile kind of respiratory sound: both these circumstances may disguise the phthisical signs, but only partially, for there will still be some decided irregularities in the sound of percussion, and enough of the signs of the subjacent cavities to declare the case to the wary observer. Occasionally a hollow or bottle-like sound is produced by percussion over a cavity; this is when its walls are pretty dense, and it communicates freely with the bronchi. More commonly there is an opposite condition: the walls of the cavity are loose and yielding; and if it be large, percussion may sometimes cause a motion of its contents, and a gurgling or tinkling expulsion of air from it, which gives a muffled metallic sound, like that of money in the nearly closed hands, or more like the imitation of that noise which may be made by striking the hands hollow and closed upon the knee. Laennec compared the sound to that emitted by a cracked jar when it is struck.

With the irregular and deficient sound on percussion, generally most evident under the clavicles or in other parts of the upper regions of the chest, there is very commonly associated a collapse or sinking in of the walls of the chest, forming below the clavicles a hollow, generally more conspicuous on one side than on the other. There is very commonly, also, some defect and irregularity in the movements of the chest, the upper ribs of one side being but little raised, and the lower parts altogether exhibiting the most motion. But there is rarely that complete fixing of the side that we see in chronic pleurisy, in which case, too, the upper part is generally more mobile than the lower.

We might class with the physical signs the characters of the sputa in the third stage of consumption, if they came only from the cavities which are peculiar to it. The expectoration of distinct portions of tubercle, or of pulmonary tissue, which are seen in a few cases, constitutes a physical sign of the clearest character; they must come from cavities. If patients could save all their expectoration, and this were inspected daily, this unequivocal sign might be more frequently met with. But the inflamed air-tubes are, in a great measure, the source of the expectorated matter, which, therefore, presents much of the same aspect as in chronic bronchitis. The large size, and almost perfectly purulent character of the masses sometimes expectorated, which are like irregular balls of flock or wool of a yellow or greenish colour, sinking and breaking down in water, go far to prove the existence of cavities in the lungs. These have been particularly

noticed by Dr. Forbes. A dirty yellowish-brown or greenish matter, occasionally fringed or streaked with blood, flattening like a piece of money when separate, and in masses forming a smooth sluggish purilage, are more characteristic of phthisis, and generally occur in the most advanced stage. The general pulmonary congestion which frequently precedes death, is often announced by the darker reddish or green hue of the purulent sputa. Profuse hæmoptysis does not often occur in the advanced stages of consumption; for the vessels soon become plugged with fibrin, and obliterated in the diseased portions of lung, and the mass of blood is reduced to the capacity of those that remain free.

When it takes place, however, it is usually followed by speedy, sometimes by immediate death. I have seen several cases in which a sudden effort, or a paroxysm of coughing, produced a gush of blood into the bronchial tubes from a large vessel in the cavity. In these cases a portion of the blood is discharged from the mouth, more by vomiting than spitting, and a portion flows into the stomach and forms a coagulum. G.

Complications. It is very common for phthisis to become complicated with other diseases of the chest, particularly bronchitis, pneumonia, and pleurisy; and the attacks of these additional lesions sometimes prove fatal, even when the phthisical changes are not extensive. Partial bronchitis is an almost constant concomitant of tuberculous disease of the lung; but more general attacks also sometimes occur from the ordinary causes, such as exposure to cold, the epidemic prevalence of influenza, and febrile diseases: they then bear a character more formidable than usual, being themselves less tractable, and may cause suffocation; or they may accelerate the progress of the phthisical disease. It is also very common to find general pneumonia attacking a lung in which there are miliary tubercles, which must have existed prior to the inflammation, and would probably not have run their course for several months. This complication greatly increases the danger of the pneumonia also, which, unless it be stopped at its very onset, generally proves fatal. In some instances, especially in the young, we find a reason for the intractability of such a pneumonia, in the tuberculous character of the hepatisation, which has the grayish or boiled-liver aspect, with considerable softening, instead of the redder deposit of common hepatisation; on the pleura there is sometimes seen, at the same time, an opaque friable lymph which borders closely on real tuberculous matter. In other instances, where the disease has not advanced far enough to present these appearances, we can still understand that there may be in the deposit enough of that defect of vitality, which renders tuberculous matter so difficult of absorption. The supervention of the signs of an extensive pneumonia, crepitation with increasing dulness on percussion, affecting the posterior lobes of one or both lungs, together with the increased heat, febrile disturbance, and the rusty tinge of the sputa, must be looked on as indicative of extreme danger to patients with any extent of phthisical disease; for if it do not itself prove fatal, as it commonly does, the inflammatory attack will not fail to hasten and increase the phthisical disease. It is different with the circumscribed pneumonia which sometimes attacks portions of lung in the progress of tuberculous disease: these come on without much disturbance, and subside without causing much mischief, being probably the result of mere local obstruction or irritation. The same remark applies to the slight pleuritic attacks, which are very common in phthisis; the effects of which are seen in the adhesions of the pleura, so generally found in phthisical subjects. We have repeatedly heard a sound of friction in a part of the chest which lasted for several days, and the chest after death exhibited adhesions at this point. Probably the inequalities occasioned by the deposits in the lung, as well as the textural irritation, cause these local inflammations of the pleura. They rarely produce much effusion, but soon terminate by adhesion. Liquid effusions do occasionally occur, from a more general cause of inflammation, such as the bursting of a vomica into the pleura. If the vomica also communicate with the bronchi, there will be

pneumothorax as well as liquid effusion. In either case, the pleurisy is a serious and untractable addition to the consumptive disease, and may prove fatal in a few hours. Pulmonary hæmorrhage is another serious accident, most commonly occurring in the early stages of phthisis. It may prove fatal, by loss of blood, or by suffocation; or the effusion of blood may break up the tissue of the lung to a great extent, and the patient may sink from the sloughy suppuration which ensues; or, after the hæmorrhage has ceased, inflammation may arise in and about the hæmorrhagic consolidation, and involve the lung in a destructive sup-puration, which may be more or less of a tuberculous character.

Varieties. The varieties which pulmonary consumption presents are very considerable, and even recent authors, such as Laennec, Clark, and Stokes, have thought several deserving a distinct consideration. Laennec recognises five: 1. Regular manifest phthisis; 2. Irregular manifest phthisis; 3. Latent phthisis; 4. Acute phthisis; 5. Chronic phthisis. Sir James Clark also notices five: 1. Acute; 2. Febrile; 3. Chronic; 4. Latent; 5. Infantile. Dr. Stokes specifies no less than six varieties of phthisis besides those diversified by complications; 1. Acute non-suppurative; 2. Acute suppurative; 3. Chronic progressive; 4. Chronic ulceration following pneumonia; 5. Tubercle consequent on chronic bronchitis; 6. Tubercle consequent on the cure of empyema. None of these divisions is sufficiently comprehensive to include all the varieties of pulmonary consumption, which may take a peculiar stamp from the nature of its causes; from the constitution of the subject; from the predominance of particular symptoms, such as those of irritation or those of colliquative secretion and decay; from the extent and progress of the local lesions of the lungs; and from the complications with lesions of other organs. It is highly important to observe these differences in relation to the diagnosis, prognosis and treatment of individual cases; but to describe them all as distinct varieties would lead to needless refinement and prolixity. It will be sufficient for our purpose to distinguish two kinds of consumption, the *acute* and the *chronic*, without however professing that the line between them is always well marked, and admitting that each may present considerable variety in its predominant symptoms.

Acute or rapid Phthisis. Sir J. Clark states, from collating the observations of Heberden, Bayle, Andral, and Louis, that the average duration of consumption ranges from nine months to two years; in the acute form it may prove fatal, in from three weeks to two or three months. In some of such cases the symptoms and stages do not differ from those already described, but they are unusually severe and rapid in their course; emaciation does not proceed so far; and the physical signs during life, as well as the examination after death, show that the extensive tuberculous deposit, and the consequent lesions of the lung, have been the sufficient cause of this rapid progress. 'This is what is popularly called "galloping consumption;" it commonly occurs in very scrofulous constitutions, particularly in young subjects, and is often developed by an attack of inflammation of the lungs or their membranes. In other cases, miliary tubercles are developed in such great numbers, that they prove fatal in their first stage, few of them having suppurated. In such instances there is generally a predominance of the signs of irritation and obstruction; dyspnœa; frequent cough, with little or only bronchitic expectoration; much fever and quickness of pulse; frequently palpitation; sometimes hæmoptysis; and the disease may prove fatal in from three weeks to two months, often without considerable emaciation, but with increasing oppression to the function of respiration. The lungs are found thickly studded with miliary tubercles, or with numerous nodules of tuberculous consolidation of a gray or a drab colour and moderate consistence, none of which have become excavated, except perhaps in the upper parts of the lungs, where a few have become soft and have formed small vomicæ. The intermediate tissue is sometimes in the first stage of inflammation; sometimes it is unaffected or partially emphysematous. The bronchi are almost always inflamed, and filled with a spumous mucus, and not unfrequently they are partially dilated. This non-suppurative variety of acute phthisis is noticed by Dr. Stokes

as usually succeeding to fever, particularly that of a typhoid kind.* From the general prevalence of fever throughout its course, Sir J. Clark terms it *febrile phthisis*; but he does not sufficiently distinguish it from his other acute variety, in which the tuberculous changes are more complete, and in which the tuberculous deposition is often in the infiltrated or diffused form. From the general symptoms, this form of acute phthisis is liable to be mistaken for bronchitis or pneumonia, and it is only by attention to the physical signs, as well as the progress of the whole case, that the distinction can be made. Of this we shall speak under the head *Diagnosis*.

Chronic Phthisis. Tuberculous consumption is in its ordinary career a chronic disease; but the cases that especially deserve this title, are those in which the disease lasts for many years. Bayle and Laennec record instances in which patients appear to have had the disease thirty and forty years. But it is not to be supposed that in chronic cases the disease is always progressive. It owes its long duration to its limited extent; and although the lungs are never free from some of the lesions described as characteristic of phthisis, yet the continuance of the disease is chiefly marked by many successive attacks and partial recoveries, dependent on the partial development of new tubercles and their successive changes and elimination. As the rapid form of the disease occurs chiefly in young subjects, so this in most instances is met with at or after middle age; but it is by no means confined to any period of life. In many instances it wears the garb of a common pectoral catarrh, recurring frequently in cold weather, and in great measure subsiding during the warm season; but on attentive observation it will be found that the attacks, although in great measure bronchitic, are attended with more purulent expectoration, hectic fever, and loss of flesh than those of simple bronchitis, and that the cough is never entirely removed, and the patient rarely quite recovers his flesh and strength. He may return to his usual pursuits, and consider himself recovered, but he is somewhat short-breathed, and suffers from any unusual exertion, which may sometimes induce hæmoptysis. With the return of winter the pectoral symptoms recur, to be again alleviated or removed in the summer, until at last one attack, more severe than the rest, proves fatal, or the disease makes more rapid and decisive progress in consequence of the failure of the constitution or the spread of the local disease. The physical examination of such cases, even at an early period, generally furnishes pretty clear evidence of the existence of phthisical lesions; for although these are limited in extent, they produce signs the more contrasted with those of the healthy parts of the lung. Hence under a clavicle, at a scapular ridge, or in some circumscribed spot in the chest, there are dullness on percussion, deficient or bronchial respiration, and undue resonance of the voice, or, as the disease advances, the different signs of a cavity before described. In such cases the long continuance or frequent recurrence of bronchial rhonchi in one particular spot, affords, as Dr. Stokes has observed, strong presumptive proof that tubercles are there irritating and pressing on the air-tubes. It is this chronic or limited form of tuberculous disease that affords the best chance for the remedial powers of nature and art; and there can be little doubt that a considerable number of cases are cured.† The lungs of those who have died of chronic phthisis present appearances that can be distinctly referred to different dates. In the upper parts there are often old cavities lined with a false membrane with hard black tissue around them, the exterior of the lung being irregularly puckered and nodulated by the indurations, the contraction of membranes, and the emphysematous distention of the uncondensed texture. The old date of these changes is plain from their hardness, and gray colour, and the complete organization of the false membranes lining the cavities, or uniting their sides. Near the same parts, but more abundantly in the middle and lower parts of the lung, there may be cavities

* It would be more correct to say *often*.—[AM. ED.]

† There is no doubt that many such cases recover. Cicatrices or calcareous tubercles remain often in healthy persons.—[AM. ED.]

of more recent formation, with their walls, comparatively soft, ragged, or imperfectly lined by albuminous matter; and there may be likewise more or less of the different kinds of consolidation—circumscribed and diffused, gray, red, and dark-coloured,—which constitute the earlier stage of phthisical lesions, in parts generally exhibiting the changes into crude and soft tubercle. It is sometimes not difficult to recognise, in these different appearances, the lesions which have been connected with the several successive attacks which the history of the patient records. Laennec adverts to these successive productions of tuberculous disease, which he calls *crops* of tubercles.

But many of those affected with chronic phthisis, or circumscribed tubercle of the lung, die sometimes from other diseases connected with this lesion, such as hæmoptysis, pneumonia, bronchitis, pleurisy, perforation of the pleura; sometimes from causes unconnected with it, such as fevers, inflammations of other viscera, accidents, &c. These cases give us the opportunity of seeing consumptive disease in its slighter forms; and they are so common beyond middle age as to have been met with in more than half the cases in which we have thoroughly examined the lungs of subjects who have died of various diseases in London and Paris. It is easy to discover these partial lesions, on feeling the lungs between the fingers, and cutting into any resisting or indurated portion, which will be found to be a gray or red induration, a yellow or cretaceous tubercle, or the remains of one, a smooth cavity or a cicatrix, to which may sometimes be traced obliterated bronchial tubes. In a few instances we have met with cavities of a considerable extent, without any remains of tubercle, the walls only being composed of condensed pulmonary tissue, smoothly lined by a false membrane, which sometimes is opaque, fibrous, and rather thick, and sometimes as thin as mucous membrane. We shall presently revert to these facts as proving that phthisical lesions are generally destructive, on account rather of their extent and constitutional origin than of their nature.

Laennec and several subsequent writers have treated of *latent* phthisis as a distinct variety: but seeing that the cases falling under this denomination differ from the common, the acute, or the chronic forms of consumption, only in their general symptoms being less marked than usual, or being disguised by the symptoms of various other affections with which the disease is complicated, it does not seem correct to separate them into a distinct variety. But it is highly important to know that all the varieties of phthisis may present very different degrees of prominence in the usual symptoms, and that they may be masked, even to their last stages, by affections of other organs, particularly of the stomach, intestines, and liver, and by various fevers, as well as by previously existing or concomitant affections of the respiratory apparatus, especially bronchitis, laryngitis, pleurisy, and pneumonia. In all these cases the physical signs will generally furnish the means of diagnosis: but in many instances the general symptoms likewise, if attentively studied, will indicate the nature of the disease; and it is from inadvertency on the part of medical men, and from their preconceived notions and those of the patients, as much as from the obscurity of the symptoms, that phthisis is so frequently overlooked. We think it necessary to warn the young practitioner not to conclude that a cough is merely a “stomach cough,” a “liver cough,” or an “hysterical cough,” because there is marked disorder of the corresponding organs, nor that shortness of breath and night sweats proceed from general debility; nor that symptoms are not phthisical because the patient has long suffered from pulmonary catarrh or chronic laryngitis, until he has found, on repeated examination, no physical signs of phthisis in the chest.

Origin and causes. If we attend to the history of different cases of pulmonary consumption, we shall find that they may be classed in three groups. 1. Those in which the individuals had enjoyed very good health until they were attacked with one or more severe colds or inflammations of the chest, or a fever accompanied by pectoral symptoms, sooner or later after which the phthisical disease commenced. 2. In other cases, again, the cough and other symptoms begin very gradually, without any very obvious cause, and, with as little appa-

rent external reason, soon increase to a serious extent, and the consumption runs a more or less rapid career. 3. In a third class of cases, the patients have been out of health, in a debilitated or cachectic state before the commencement of the cough and other local symptoms, which become developed after exposure to cold, the stoppage of an habitual evacuation, or some other cause likely to occasion local irritation or plethora.

1. In the first class of cases we have the development of phthisis from local inflammation or irritation without any evidence of prior constitutional disorder, unless an hereditary predisposition, which may be traced in some of these cases, may be considered as such. The acute inflammation, whether pulmonic, pleuritic or bronchial, imperfectly treated and only partially subdued, passes into a chronic form, and either immediately develops phthisical indurations in the lungs, or by generally lowering the vital powers leads to their formation from perverted nutrition, or from the irritation of any fresh exciting cause. Under any of these circumstances, chronic inflammation, either by its own local effects, or by its depressing influence on the constitution, or by both combined, becomes a sufficient cause of pulmonary consumption. As it might be anticipated, consumptive disease arising in this way is often more limited in its extent, and manageable in its course, than that arising from a prior constitutional disorder. As the cause is more local, so the lesion is more confined to a part; and we see instances of it in the very partial indurations and other phthisical lesions, or the traces of them, which we have lately noticed as occurring frequently in the lungs of persons who have died of other complaints. The physical character of these lesions in many such cases clearly identifies them with those which in greater extent constitute chronic phthisical disease. Yet the same local causes that produced these limited or solitary tubercles may engender many; and the greater the number that the local cause thus develops, the more effect will it have on the constitution which in a manner takes on a disposition to evolve the new production; hence, therefore, out of a local cause, such as latent or neglected pneumonia, pleurisy, or peritonitis, may arise a general tuberculous disease, involving more or less the whole system. Among the local causes of consumption is to be reckoned the habitual inhalation of fine solid particles, which is contingent on certain occupations, such as those of needle pointers, dry grinders, stone-masons, miners, colliers, and such like. The lesions in these cases are, as might be anticipated, bronchial as well as parenchymatous; and it has been questioned whether the consolidation of the lung which is found is really tuberculous; but seeing that it tends in the same manner to softening and the formation of vomicae, that granular indurations and distinct yellow tubercle sometimes accompany it, and that the symptoms and signs are those of pulmonary consumption, we see no reason for distinguishing between them. The dependence of the disease, in these cases, on the mechanical irritation of the inhaled particles, is sufficiently proved by the fact that these particles have been found in considerable abundance in the indurated lung, particularly in the case of the Edinburgh stone masons and the workers in coal mines, the texture being in the latter case completely blackened by the coal dust. In the case of the steel-workers at Sheffield, described by Dr. Knight, the fork-grinders, which grind dry, do not reach thirty-two years of age, whilst the knife-grinders who work on wet stones, generally live to forty or fifty. The workmen employed in making gun-flints in the quarries of St. Rock are said by MM. Benoiston de Châteauneuf and Clozier to be sooner or later attacked with pulmonary disease, generally tuberculous; and, however robust, originally, few pass the age of forty. With such cases may be associated the results of the experiments of Saunders, Cruveilhier, and others, in which lesions resembling those of phthisis were produced in the lungs of animals after the injection of mercury into the air-tubes or blood-vessels. The inhalation of vegetable or animal dust or particles does not appear to be so injurious, except in the case of the feather-dressers, brush-makers, and flock-carders. According to M. Benoiston, the average mortality in the former from phthisis only amounts to

7½ per cent. for males and 11½ for females. The injurious character of these employments may be explained, when we consider the irritating character of particles of feathers and hair, and how little they can be softened or decomposed by the animal fluids. It has been maintained that the production of tuberculous disease in these different employments, is due as much to a bad state of the constitution induced by confinement, abuse of spirituous liquors, &c., as to the local irritation: we do not deny that this may have a share; but the greater influence of the perpetual local irritation is apparent from the fact, that in other occupations in which the confinement and habits are quite as bad, not one-fourth so many die of consumption.

2, 3. We may well consider the second and third classes of cases together, for in both the disease has its root distinctly in a state of the constitution, and they are distinguished only by an occasional or local cause being obviously added in one class, and not in the other. Unfortunately these form the most numerous group of consumptive cases, and those over which, when once formed, medicine has but little control. The cachectic condition of the system which precedes the formation of tubercle, as well as the circumstances that seem to occasion it, fully correspond with the pathological views which we have taken of its nature. Imperfect nutrition, whether from deficient or improper food, or from a permanently disordered state of the digestive or assimilative organs; unhealthy air, whether from closeness, humidity, or impurities; long continued exposure to cold, as from insufficient clothing, where there is not enough vascular irritability to lead to inflammation; depressing passions, such a disappointed love, anxiety, or distress from reverses of fortune or other severe calamity; venereal excesses; repeated courses of mercury; profuse and very weakening discharges; adynamic fevers, and the atonic state that sometimes succeeds to exanthematous fevers; irregularities of the uterine function, especially those that lead to chlorosis; the sudden suppression of habitual discharges or of long established cutaneous eruptions; these singly or combined are the most common causes of the constitutional origin of tuberculous disease. They all tend to destroy the balance of the functions and diminish the tone of the system, and with it that rich fibrinous and vital condition of the blood, by which proper nutrition and the organic functions are sustained. The impoverished blood, defective in that vital albumen with which the tissues are fed and renewed, deposits in its stead a degraded matter, imperfectly or not at all organizable, like that resulting from the lower degrees of local irritation or inflammation. The lungs, the lymphatic glands, and a few other organs, become the first seat of these deposits, because their textures are in fuller relation with the blood than those of other parts are; and if there be in these organs also a congestion, an irritation, or an inflammation, the deposition becomes more extensive and rapid in proportion: although the inflammation be acute, it may also produce organizable lymph, together with the degraded albumen, tubercle; so, also, we find, that according to the natural activity of the nutritive process will be the rapidity of the tuberculous deposition and the progress of the disease. In young persons nutrition is most active, so is consumption more commonly spontaneous and rapid; and at no period is this more manifest than between the ages of eighteen and twenty-five, when growth becomes completed, yet the vessels and their blood do not immediately lose their habit of deposition. This view also corresponds with the fact stated by Andral, Lombard, and others, that of young persons, consumption shows itself earliest in females, in whom growth is sooner completed than in males. But throughout the whole period of childhood and of youth, tuberculous disease is very common, and under the influence of the causes already enumerated is more easily engendered than when nutrition is less active. From the tables collected in the work of Sir J. Clark it appears that more than one-fourth of those who die from birth to puberty are affected with tuberculous disease. We can understand why this morbid nutritive activity, this disposition to deposit tuberculous matter, should be particularly shown in women after the completion of utero-ges-

tation, and in persons on the speedy healing of large suppurating wounds—circumstances which, as long as they continue, are known often to suspend the progress of consumptive disease.

Our limits will not permit us to go into many farther details respecting the causes of tuberculous disease or of the cachectic condition on which it depends. Sir James Clark lays much stress on abdominal plethora, or congested state of the portal system of blood-vessels, as the chief cause of this condition; and there are many facts which favour the opinion that congestions of various internal parts frequently precede the development of consumption; but it is a question whether we may not take a link higher in the chain of causes, and view defective or irregular action of some of the principal secreting organs, or of the capillary circulation in general, as the precursor of these congestions. Signs of such defective action occur in scrofulous constitutions more constantly than those of abdominal plethora, and are manifested in coldness of the extremities, blueness of the nails, flushing of the face, a dry harsh or a flabby state of the skin, relaxed throat, scanty and high-coloured urine, irregular bowels, uncertain appetite and variable strength. In many cases pulmonary consumption has been preceded by such a condition of the system, and in such instances the disease may begin very gradually without any very obvious exciting cause, or it may be suddenly developed by an inflammatory or febrile attack. It must, however, be confessed, that such a condition of the system is often met with without being followed by consumption; and not a few cases of consumption occur without appearing to be preceded by any such disorder of the health.

The hereditary origin of tuberculous disease is established by the concurrent testimony of almost all writers, and it may be considered as one of its most fertile sources. Sir J. Clark says that it is transmitted more often to the younger than to the elder children of a consumptive family; and he believes that a deteriorated state of the health in the parent from any cause, such as gout, severe dyspepsia, cutaneous diseases, debility from disease or from age, may give rise to the scrofulous constitution in the offspring. The same writer has very judiciously remarked, that even in those not inheriting it, a disposition to tuberculous disease may be readily induced by bad nourishment, confinement in impure air, and neglect of cleanliness during the whole period of their growth, and more especially in early years. A child under such circumstances, although born in health and of robust parents, becomes pale and thin, with a tumid abdomen and enlarged glands, and fetid evacuations; and unless speedily removed from these unfavourable circumstances, soon dies of some form of tuberculous disease. The same thing is observed of the lower animals: thus, the cows confined in close stables in towns, become tuberculous; and rabbits may be rendered so in the course of a few weeks, by keeping them in a close damp place, and giving them only poor food. Partly to the confinement must be ascribed the fact that many of the monkeys brought to this country die tuberculous; but the change of climate must also be considered a chief cause, for negroes who come to this country are especially liable to phthisis.*

Phthisis prevails more in temperate than in hot or very cold countries. It is the cause of nearly a third of the mortality in London, and not much less in Paris; whilst in Russia and in the East Indies, it is far less prevalent. In the West Indies, however, it appears from the table of Sir James Clark to be very destructive among the negro troops, where it constitutes one-half of a large mortality; and in the East Indies a considerable number of Malays, Caffres, and Indians, fall victims to the disease, which constitutes from one-eighteenth to one-seventeenth of the mortality, while among the Europeans it does not cause one in five hundred deaths.

Diagnosis. Having already entered pretty fully into the signs and symptoms

* Even negroes who are born in temperate climates die of phthisis in a greater proportion than whites. Their unfitness for the climate is at least one cause of this.—[AM. ED.]

of tubercles of the lungs, it will not be necessary to dwell long on the subject of diagnosis. In the greater number of instances the features of the disease, together with the physical signs, are quite distinctive; but it often happens that the early stages are rendered obscure by certain complications, and it becomes difficult to distinguish, whether, in addition to the more obvious disease, tubercles are present or not. These complications are chiefly bronchitis, pneumonia, and pleurisy, and the diagnosis is to be made between them combined with tubercle, and the same simple.

Acute phthisis often begins with the signs of general acute bronchitis, accompanied by much febrile irritation. But when tubercles are present, the sound on percussion is more or less impaired; in some parts of the chest the quickness of pulse is unusually great; there is more tendency to night perspirations than in simple bronchitis; and the symptoms instead of reaching an acme and then declining, with a change in the expectoration and in the character of the rhonchi, continue, and even increase whilst the patient daily loses strength and flesh. In the generality of cases, simple bronchitis prevails most in the middle and lower parts of the chest; that accompanying tubercles always extends to the upper, and often occupies these chiefly. The complication of tubercle with pneumonia, which is a very acute form of phthisis, may be generally distinguished from simple pneumonia, by its commonly occupying both lungs and progressing from above downwards; from the less rapid increase of the consolidation, by the decidedly hectic form of the fever after the first few days; and by the early production of the signs of cavities accompanied by copious purilaginous expectoration, and sometimes hæmoptysis; none of these signs are usual in simple pneumonia. To distinguish in a case of pleuritic effusion, whether tubercles are present or not, may be a matter of great difficulty. With regard to the compressed lung of the affected side nothing can be determined, and as there is no longer a standard of comparison for the sound side, absolute signs alone can be depended on, such as decided dulness, bronchial or cavernous breathing, or pectoriloquy under the clavicle, or a permanent mucous or subcrepitant rhonchus. In the entire absence of these, and when the respiration is clear and puerile throughout that side, and the general symptoms and the aspect of the patient is not tuberculous, it may be presumed that there are no tubercles.

We have before adverted to the difficulty of distinguishing between simple chronic bronchitis and that accompanying limited or early tuberculous disease; and we must refer to the description of the physical signs for the chief means of diagnosis. Without attention to the physical signs, chronic pleurisy is very liable to be confounded with phthisis; they never fail to furnish a diagnosis in the much more complete dulness and absence of respiration in pleurisy, particularly in the lower part of the chest, on one side only; in the enlargement of this part and the smoothness of the intercostal depressions, which contrast strongly with their sunken condition in phthisis. When the effusion has been partly removed, and partial contraction of the chest taken place, although from the dilatation of the tubes there may be pectoriloquy and other signs of cavities, yet the alteration of shape affects the side more extensively than phthisis does, and a perfect dulness remains in the inferior parts, which is quite unlike the condition induced by phthisis. The different character of the expectoration also will form another ground of distinction. Dr. Stokes thinks that tubercles are not uncommonly produced during the absorption of an empyema, and mentions, as their signs, the occurrence of symptoms of new pulmonary disease, with hectic, quickened pulse, an increasing dulness and signs of irritation under the clavicle or scapular ridge.

Phthisis is sometimes disguised by chronic laryngitis; the affection of the voice, character of the cough, and other symptoms directing attention exclusively to the larynx; but we have before remarked that extensive ulceration of the larynx is very commonly accompanied or succeeded by pulmonary tubercle; and on careful examination, the signs of this may generally be found under one or both clavicles by the respiration or by percussion, if not by the voice.

There is one kind of lesion which, even in its physical signs, is liable to be mistaken for tuberculous excavations; this is dilatation of the bronchi. This may be the seat of a coarse gurgling rhonchus, cavernous breathing, and pectoriloquy; and the accompanying chronic bronchitis often causes also purulent expectoration. The situation, greater extent, and more stationary character of these lesions may serve to distinguish them: they most commonly occupy the scapular, mammary, and lateral regions, and not the infra-clavian; they usually extend over a considerable space, but do not tend to spread as tuberculous cavities do. Again, if they arise from disease in the bronchi only, they do not impair the sound on percussion so much as phthisis does; and if they originate in the pleuro-pneumonia, the dulness is much more complete, is confined to one side, and is accompanied by a more marked contraction than that which occurs in phthisis. But the general symptoms should also be taken into account. There is seldom with dilated bronchi the degree of hectic emaciation which occurs in phthisis; and when they arise from condensation of the lung, there are often œdema and general dropsy, which are not common in simple phthisis.

The diagnosis of phthisis is easy enough in the advanced stages, or even in the second period before softening has taken place. The physical signs conjoined with the general symptoms are then conclusive; but in the early stages of the disease the diagnosis is often difficult. If phthisis be regarded merely as a local disorder, the signs of it will be frequently deficient, because the local mischief is formed very slowly, and at first is so slight as to produce very insignificant obstructions to the respiration, and very little tendency to cough. If the disease of the lungs be regarded merely as a part, and as it were, a sign of a general disorder, which is usually betrayed by certain symptoms, the diagnosis is greatly facilitated.

Regarding the disease in this light, the following circumstances will guide us in forming a probable and often a certain diagnosis in commencing phthisis. If the physical and other local signs are added to the symptoms referrible to the constitutional disorder, the diagnosis is of course much more unequivocal than in those cases in which the general symptoms are alone formed.

1. The diagnosis in these cases is formed in part by way of exclusion; that is, many of the symptoms of the general tuberculous disease acquire their chief value from the absence of any apparent lesion which is capable of producing them. If they occur in young persons, especially if from hereditary causes or habits of life they are exposed to phthisis, the probability of the development of this disease is of course enhanced, and the diagnosis is assured.

2. In chronic cases of phthisis, the general signs are emaciation, which is often accompanied by a good appetite and a tolerable digestion, and a changed colour of the skin, which seems dusky or earthy in its hue. Rounding of the extremities of the fingers, and a bluish tint of the sclerótica and the occasional flush of the cheeks have long been known as frequent symptoms of phthisis, but are less important than the colour of the skin and emaciation. There are a number of other general symptoms which are occasionally met with in commencing phthisis, but they are more or less irregular in their appearance, and are therefore of value only to one who is perfectly familiar with them.

3. In acute cases the disease is generally characterized by high and continued fever, with a quick jerking pulse; the fever continues throughout the whole twenty-four hours, but is more severe in the after period of the day than at any other time, and at night is apt to terminate in profuse sweating. There are sometimes chills in this stage of the disease, but this is by no means universally the case; in this respect the formative fever of tuberculous diseases differs from the hectic of the latter stages of it. The character of the pulse is almost peculiar; it is very quick, irritated, and more readily distinguishable by the finger than easy to describe. The fever is almost pathognomonic of acute phthisis, if there be no decided local lesion or other obvious means of explaining it. The fever is much more similar to that observed in some varieties of inflammation of serous membranes, especially empyema, than to the ordinary hectic. And this similarity in the constitutional symptoms of the pleurisy and other inflammations of the serous membranes of the chest, is one of the points of connexion between

these diseases; seeming to show that in these cases the morbid action of the body is very analogous if not precisely similar.

4. The last means of diagnosis by the general symptoms, of commencing phthisis, is the existence of certain affections which are closely connected with the disease; these are the inflammations and the tuberculous diseases of other organs than the lungs, such as the small intestines and the serous membranes. When these are discovered they often explain the nature of a tuberculous disease of the lungs, and are sufficient to distinguish it from ordinary inflammations.

G.

Prognosis. In a disease which causes so large a proportion of the mortality of the human race, it may well be supposed that the prognosis is generally most unfavourable; until Laennec discovered sure means of detecting tuberculous lesions, and also proved by anatomical researches that they are sometimes cured by a natural process, it was generally believed that they were quite incurable and must sooner or later prove fatal. In making these discoveries, Laennec altered the state of our knowledge, chiefly by showing those to be cases of consumption which were formerly not admitted to be such, simply because they recovered. After the diagnosis has been distinctly made by aid of the physical signs, and the disease proved to be tuberculous, the prognosis is to be formed chiefly through the general symptoms. The extent of the pulmonary lesion, may, indeed, only be determined by the physical signs, the dulness of percussion and respiration, the rhonchi, resonance of the voice, and signs of excavation, whether they are confined to a small space or extend to a considerable portion of both lungs; and, in the latter case, the rapid progress of the disease to a fatal termination may be at once prognosticated. But where, as is often the case, the physical signs establish the presence rather than the amount of the disease, we must refer to the state of the general health, to determine the probable time during which the constitutional strength may struggle against the disease, and the chance, if there be any, that it may get rid of it. When the cough and dyspnoea are distressing, with copious purulent expectoration; the pulse constantly quick; the accessions of hectic severe, with or without night sweats; the loss of strength and flesh considerable and progressive,—no hope can be entertained with regard to the result, which will terminate unfavourably in a short time. When the dyspnoea is considerable, death generally takes place before the emaciation is extreme; and this is commonly the case in acute phthisis, and where the fatal termination is caused by an inflammation or hæmorrhage of the lungs supervening on the tuberculous lesion. In such cases, œdema of the feet, face, and other parts sometimes precedes death. But in the less rapid cases, and those which run their full course, the emaciation is excessive, and nothing increases it and the weakness so much as the colliquative diarrhœa, which generally occurs in the last stage of the disease. Shortly before death, the expectoration is sometimes suppressed, and sometimes it is changed in appearance, being a dark dirty green, or a reddish purilage with no mixture of mucus or froth.

The progress of the more prolonged cases is rarely uniform; it is marked by a series of attacks of increased symptoms, with a temporary amendment between them. This increase is generally referred to the weather, or increased exertion, and under favourable circumstances may be decidedly checked. Thus, patients often pass several years, losing ground in the winter and spring, and rallying somewhat during the summer, until, at length, they sink either under an attack severer than usual, or fairly consumed by the reiterated attacks of the disease. In some cases the improvement is more decided and lasting: the fever abates; the pulse loses its frequency; the cough subsides, and the expectoration becomes mucous and nearly ceases; and, in a few instances, the disease is entirely removed, and the flesh and strength restored. The local signs that countenance the hope that such an improvement may be lasting, are, a diminution of the pectoriloquy, cavernous breathing, and other signs of the excavations, the restoration of some vesicular respiration and sound on percussion to the part, whilst in the rest of the

lungs the sounds are natural. There can be little hope of permanent improvement if there is strong hereditary predisposition, or marked symptoms of tuberculous cachexia, or any functional or constitutional disorder which materially impairs the general health.

Treatment. We have been led to conclude that the most important elements in the production of phthisical lesions are, a state of constitutional weakness or defective nutrition, and a local vascular irritation or congestion: these elements predominate in various proportions in different cases, and will require a corresponding variation in the treatment; but in almost every case, both the constitutional and local causes must be duly investigated and treated, or success will be only a matter of the most incalculable and irrational chance. In treating of the causes of consumption, we arranged cases in three groups: 1. Those arising from local disease; 2. Those originating from constitutional disorder, or hereditary predisposition, without any known previous local disease; and, 3. Those arising from local disease in subjects of hereditary or acquired scrofulous or phthisical constitution. In the last two, constitutional causes are recognised; and in the first, the local disease may act, not only by developing in the lungs lesions which tend to run a phthisical course, but also by injuring the functions generally, so that here, too, a constitutional cause becomes added. In no case, therefore, should we exclude constitutional treatment from a prominent place in the management of consumptive patients. It is where local disease has been the chief cause of the mischief, that we have the best chance of curing consumption, and the more so in proportion as the local lesions are limited, and the constitutional powers little impaired.

The chief indications in the treatment of tuberculous disease are, to diminish those local irritations and congestions that lead to the formation of the indurations or tubercles; to correct the condition in the system which degrades the nutritive process, and disposes to the deposition of imperfectly organized products; to promote the removal of those already deposited; and to treat troublesome symptoms and accidental complications. These indications will predominate very differently in different cases, and in the different stages of similar cases; and although all should generally be kept in view, it will be more convenient to consider the treatment in relation to the stages of the disease than to these separate indications.

First stage. The symptoms of the early stage, that of the indurations, are those especially of vascular irritation and obstruction; hence this is the period at which antiphlogistic and counter-irritant remedies avail most. General blood-letting of from four to eight ounces, repeated every week or ten days, were highly recommended by Morton, Dovar, Fothergill, and Pringle, and more recently by Dr. Hosack of New York, and Dr. Cheyne of Dublin. The practice is still much pursued in this country; and if judgment be used with regard to vascular strength of the subject, it is one of the most important agents which can be employed. We would, however, with Sir J. Clark, limit its use to cases in which there are marked signs of plethora, or of pulmonary inflammation, congestion, or hæmorrhage; and in other cases, and subsequently, prefer moderate local bleeding by leeches below the clavicles. The latter measure should be repeated whenever an increase of pain or cough, with a bloody tinge in the sputa, dulness on percussion, and irregular respiration or rhonchi under the clavicles, indicate a congested state of the lung about the suspected indurations.

In cases of greater debility, or where there appears to be a defect of blood in the system, blisters or other counter-irritants are more suitable than blood-letting. One of the best agents of this kind is a saturated solution of tartarized antimony, to be rubbed in below the clavicles twice a-day, until a papular or semi-pustular eruption is produced. The friction should be renewed from time to time when this eruption dies away, as the symptoms may require it. We have sometimes added hydriodate of potash to the solution, with the effect of rendering it more irritating, and perhaps of acting favourably on the constitution by being partially

absorbed. Issues and setons cause too much irritation of the system to be useful in this stage. A more moderate and general counter-irritation may be produced by sponging the whole chest once or twice a-day with salt and strong vinegar, or with a liniment of oil of turpentine, acetic acid, and olive oil mixed by the aid of the yolk of an egg, as recommended by Dr. Stokes, or with ammoniated liniment in various degrees of strength.

The efficacy of internal sedative or antiphlogistic remedies is more doubtful; except so far as they tend to diminish the irritation of the cough and the pain. Thus digitalis, hydrocyanic acid, and colchicum may, in some cases, subdue a temporary vascular excitement, and thus give relief; but the utility of continuing them long with the view to permanently reduce the pulse, may well be questioned; for they may thus do more damage to the constitution, than give relief to the irritation. In case of increasing bronchial or parenchymatous inflammation, or of fever, salines, antimonials, and other means of increasing the fluid secretions, will be proper as usual.

The narcotic remedies, such as opium, conium, hyoscyamus, belladonna, aconite, and hydrocyanic acid, are occasionally useful to allay cough and pain, especially when these symptoms are associated with high nervous sensibility or a tendency to spasm; but they have no influence on the incipient phthisical lesions, or on the inflammations or irritations accompanying them; and unless given judiciously, they may disorder the gastric and alvine function, and thus injure the state of the constitution.

But are there no remedies which will promote the removal of the induration themselves? We can answer this but doubtingly; but if we may be guided by analogy, we might be led to hope that the removal of morbid deposits, when recent, may be facilitated by the aid of certain medicines. Thus we see tumours of various kinds, enlarged glands, and depositions in the joints, sometimes reduced under the use of mercury, of alkalies, or of iodine; and although there are many forms of deposit on which these remedies exercise no influence, and others in which their power is very equivocal, yet the limits of their action are not so defined as to prove that all the kinds of induration which precede tuberculous deposit are quite beyond their reach. The influence of these remedies in promoting the absorption of the simpler products of acute inflammation is scarcely doubted; and arising, as the lesions of phthisis occasionally do, from acute inflammation, and presenting various gradations which remove them only step by step from its products, it would be unreasonable to assert, without sufficient evidence to prove it, that they are wholly beyond the reach of such medicines. Dr. Stokes considers that the strumous inflammation which constitutes incipient phthisis, may sometimes be arrested by a course of mercury producing ptyalism; and he gives two or three cases to show the success of this mode of treatment. He admits, however, that its utility needs confirmation, and its exhibition must not be lightly attempted. It may, perhaps, be useful where the pulmonary lesion originates in acute inflammation, which has not proceeded to suppuration; otherwise its influence is generally so injurious in serofulous constitutions, that we cannot advise its employment. This does not apply to its occasional use as an aperient, which is generally beneficial in this, as well as in other chronic diseases, in which the abdominal secretions need its aid.

Sir James Clark, on the ground of Dr. Carswell's view of the usual seat of tuberculous matter, has recommended anew the old practice of a course of emetics in the early stage of phthisis. The testimony of several English writers of the last century, Morton, Parr, Reid, Marryatt, &c., is strong in favour of the success of emetics in arresting and even curing the disease; but as we know that they did not possess the means of distinguishing phthisis in its early stages from other affections, we lose much confidence in their testimony. Nor are we disposed to trust implicitly the report of the only recent authority, Dr. Giovanni de Vitis, whom Sir J. Clark adduces: he states that in less than four years, 176 cases of phthisis were discharged from the hospital *perfectly cured*, 47 in the first stage,

102 in the second, and 27 in the third. But although these statements are too strong to be accepted without reserve, they are sufficient to warrant a farther cautious trial of this method of treatment, in cases where there is sufficient strength to bear it. Various emetics have been recommended. Dr. De Vitis gave half a grain of tartar-emetic in a table-spoonful of sweetened infusion of elder flowers, repeating the dose in fifteen minutes if necessary. This practice was pursued every morning and evening; the diet being farinaceous. Clark prefers an emetic of ipecacuanha, or sulphate of zinc, or sulphate of copper, using only a little fluid during its operation, and for this purpose warm camomile tea is best. It may be given every day or less frequently, according to the urgency of the symptoms. Several writers assert that emetics may be continued every other day, and even oftener, for months without inconvenience. Sir J. Clark says, "There can be no doubt that the physicians who employed emetics thus extensively, were fully assured of the advantages which they produced; and their patients, we may conclude, must have been equally sensible of the benefit derived from them, otherwise it is scarcely credible that a practice so disagreeable would have been prescribed or persevered in." The same author supposes the action of emetics to be in a great measure mechanical, dislodging the tuberculous matter, which, according to Dr. Carswell's notion, is first deposited on the free surface of the bronchial membrane. We would rather ascribe their beneficial operation to their powerful impression on the whole vascular and secernent systems, which tends to remove local congestions and obstructions, and to render all the secretions more fluid and free. It is not probable that this unpleasant practice will be sufficiently adopted or pursued as to be extensively useful; and there are many cases in which it cannot be even attempted.

We expect more from a much more manageable remedy, which we believe also to be capable of promoting the removal of phthisical lesions in their early stages, or of retarding their increase. This is iodine, in combination with different bases. We have been in the habit of giving it in incipient cases of consumption for the last twelve years. Dr. Baron of Gloucester, Dr. Morton of Philadelphia, and several others, have also spoken strongly in favour of this remedy. The form which we have found to agree best is the hydriodate of potash in small doses (two or three gr.) three times a-day with twenty or thirty drops of liquor potassæ, in decoction of sarsaparilla, infusion of calumbo, or distilled water, according to the state of the system; adding a little tincture of henbane, digitalis, ipecacuanha, wine, or other medicine that the predominant symptoms may indicate. Where there is a tendency to feverish irritation, it may be given in a nitre draught; where there is vascular debility it may be combined with mild tonic infusions. In chlorotic and in exsanguine scrofulous subjects, the iodide of iron is a suitable form; when it is borne, not causing headach and fever, or increase of cough, it rarely fails to improve the state of the general health; but it should always be combined with occasional local depletion, or external counter-irritation of the chest. When iodine agrees (and by varying its form and combination it may be generally made to agree,) it increases all the secretions, and seems to give increased activity to the whole capillary system. In cases of gastric irritation with pain in the stomach or heat in the throat, thirst and florid-tipped tongue, it should be suspended, and a dose or two of hydrarg. è cretâ given, followed by a few small doses of castor oil or a saline aperient; and after a few days the hydriodate of potash may be resumed, guarded by the frequent use of a farinaceous diluent.

In the treatment of consumption and other tuberculous diseases, no single remedy is nearly so useful as iodine and its preparations. My own practice leads me to prefer the simple solution of iodine or hydriodate of potass (\mathfrak{I} iodine and \mathfrak{I} ij hydriodate of potash to \mathfrak{v} ij of water.) The patient should take five drops of this solution three times daily, and if no inconvenience be felt, he may increase the dose gradually and slowly to ten drops. I do not give it in larger

doses, unless in some rare and exceptional cases. The hydriodate of potash may be substituted for the iodine, it is more tonic, perhaps more stimulating in its effects, but less purely alterative. If the patient be anemic, the iodide of iron is a better remedy than the iodine itself. All these preparations are best fitted for commencing cases of the disease, when the patient is labouring under slight bronchial inflammation, with commencing constitutional irritation and emaciation, and to the more chronic cases in which the tuberculous deposit is formed very slowly with little fever.

Many acute cases of phthisis, and the greater number of those which are advanced so far as the formation of cavities, are not benefited by the iodine, at least I have had no reason to be pleased with its effects. The remedy may be combined with alteratives, tonics, and many modifications may be made in its mode of administration, such as giving it only once a-day, and from time to time it should be discontinued, and may be again resumed when the temporary irritation has subsided.

Inhalations of various kinds have again attracted notice after being nearly disused. The most of them are certainly of benefit as means of relieving the chronic bronchitis which often attends and aggravates consumption. Iodine has also been prepared and used in this way. My own trials with it have led me to think favourably of it, under the same circumstances in which it acts well as an internal remedy. The method proposed by Sydenham of combining it with conium answers well, or it may be used in its pure state. A grain or two may be placed at the bottom of a tumbler, which should be immersed in a bowl of hot water, and the iodine inhaled by surrounding the vessel with a cloth, and breathing the vapour. If much irritation and disposition to coughing come on, the inhalations must be suspended, and if the patient is permanently irritated, the attempt should be given up. The iodine probably causes a decided local action on the bronchial membrane, and afterwards is absorbed so as to produce its ordinary constitutional effects. G.

But even in the cases in which phthisical lesions are most limited and merely nascent, we must never forget that it is not these lesions alone that we hope to remove. Their very presence in the system, or the operation of the constitutional or local cause that produces them, may lead to the formation of more; and in our treatment of the local causes, we should ever endeavour to remove those low degrees of vascular irritation, or that unhealthy condition of the nutrient matter of the blood, which, singly, or combined, occasion the deposition of tuberculous indurations. But the constitutional treatment is also of the utmost moment; and in this we should seek for all those circumstances and agents that may best promote the due action and balance of all the functions. The purest air, and the most suitable climate for regular and ample exercise in it; the most nutritious food that the digestive organs can easily assimilate, and that the vascular system can bear without excitement; such remedial agents as give at once tone to the system, and promote the free action of all the secreting organs, together with friction, exercise, and proper clothing to maintain the activity of the superficial circulation;—these are the means which are rationally indicated to fulfil the object of improvement of the general health. But these means must be much varied to adapt them to the wants and capacities of individual cases, and it is in the study of these, and in the power of adapting the means to them, that the ability of the practitioner is seen.

Of remedial measures, those already named in relation to the local lesions and particular symptoms, may be combined or modified so as to act favourably on the functions at large. This is especially the case with iodine. Occasional mercurial and saline aperients will be generally needed to prevent internal congestions, and to promote the sufficient action of the abdominal viscera; but they should not be carried to excess, and their operation should be aided by due attention to diet. So also the functions of the kidneys, and the skin may in particular cases be ameliorated by the aid of medicines; but the more that can be done by clothing, diet, and regimen, the better. Clothing, in particular, should be most carefully attended to; we have in it the means of affecting, sometimes powerfully,

the whole vascular system; and if so regulated as to maintain a permanently warm and supple, but not relaxed state of the whole surface and of the extremities, it would prevent many of those fresh colds and exacerbations which are the great bane of phthisical invalids. In case of these aggravations, which commonly consist in an increase of bronchitis, but sometimes are pneumonic or pleuritic, the remedies for these affections must be cautiously resorted to; always limited by the reflection that we are treating a subject that may already be weak from disease, in whom the restorative powers are lower than usual, and in whom the permanent source of irritation in the lungs will preclude that complete relief that antiphlogistic measures may give in simple inflammations.

In case of hæmoptysis, much care is required to remove the congestion or vascular fulness which occasioned it, before attempts be made to arrest it with styptics; otherwise the congestion may pass into inflammation, which, occurring in a lung tuberculated and consolidated with hæmorrhage, is particularly destructive. Moderate repeated bleedings from the arm, or by cupping, and the use of tartar-emetic in small doses, not sufficient to cause vomiting, together with digitalis and nitre, and morphia in case of nervous agitation, are the measures we have found most availing. If, in spite of this, the hæmoptysis continue to any amount, the super-acetate of lead, in the doses of two or three grains, with half a grain or less of the aqueous extract of opium, should be given every two hours, or as often as the urgency of the case may require. Fluid drinks in any quantity, especially warm, must be carefully avoided. Slight cases of hæmoptysis are sometimes effectually treated by a saline aperient, with diluted sulphuric acid; and freely opening the bowels always aids to prevent the return of hæmorrhage.

Pure country air is almost indispensable to give any chance to the consumptive. If the disease be limited and chronic, and circumstances prevent him from giving up his employment in town, he should at least sleep in the country, and take every opportunity of longer absence. But the country must be dry, and not too much exposed to the east and north: otherwise it may only change the evil from cachexia to inflammation. There is no air which is so truly an antidote to the poisonous effects of a town residence, as that of a dry sea coast; and the more open this is for the summer, and the milder and more sheltered for the winter, the better for the consumptive. The benefit that patients often quickly experience from the change is most striking, even in the more advanced stages of consumption. To profit fully by the influence of pure air, the patient should be as much out of doors as the weather will permit: and use as much gentle exercise, both by walking and riding on horseback, as the state of the strength will allow, without inducing much fatigue. To those who bear them pretty well, sea voyages are sometimes highly beneficial; during the summer season, these may be confined to yachting about our coasts or crossing our seas; but the voyage to India, the Cape, to Madeira, or to the Mediterranean, may, with advantage, be made at a later season, with the view to pass the winter in these more genial climates. Of places for winter residence abroad, Madeira, Rome, and Nice, are generally considered the choicest spots; we much prefer the former. Were there suitable accommodations for English invalids, we have reason to believe that parts of the north coast of Africa, particularly Tunis, would afford a climate better suited to the consumptive than any other of the Mediterranean. Of the milder spots in our own islands, the Undercliff in the Isle of Wight, Torquay, and Hastings, and the Cove of Cork, are most favoured; but many places on the southern and western coasts, also, present many advantages in point of mildness and equality of temperature, over all inland situations. When circumstances do not permit removal to these spots, and even in them in severe weather, the patient must be kept to rooms moderately and equally warmed (from 55° 65°, according to the feelings,) and as airy and well ventilated as they can be made without risk of draughts of air.

The selection of the best climate for consumptive patients is often a matter of considerable difficulty. To the places recommended, we may add Hyeres in France—both the mainland and the adjoining islands; St. Augustine in Florida, and several points in the West Indies, of which Santa Cruz seems the most desirable. In all, or most of these situations, consumption is more or less prevalent among the natives, but to a foreigner, the great advantages of a winter at them consist in the avoidance of the keen northern winters which are injurious to most but not to all consumptives, and the facilities afforded for abundant exercise in the open air. The journey and the change of scene are also decidedly curative, or at least palliative agents.

But much mischief is often done by indiscriminate banishment of patients from home. None should be sent who offer the following objectionable points:

1st. Those who are strongly averse to the journey, especially if the disease be at all advanced; for the moral effects which result from this species of banishment will more than counterbalance the possible advantages which might result.

2d. Patients labouring under acute phthisis with much fever should never be sent upon a journey: it is almost always mischievous to them.

3d. In the advanced stages of the disease no benefit can accrue from the journey, at least there are few exceptions to this, and then it is only allowable when the patient is himself strongly desirous of the attempt.

4th. There is a fourth class of phthisical patients who are positively injured by warm weather, and who can readily indicate the climate which is most fitted for them. G.

The diet in the early stage of consumption should generally be of a mild and unstimulating character, consisting chiefly of milky and farinaceous food. Sometimes white fish and chicken may be allowed; and a state of vascular debility, or previous habits, may make the plainer kinds of meat necessary; but this is especially the period of irritation or congestion, and more mischief is likely to result from repletion than from moderation. For the same reason fermented liquors are not generally admissible at this period.

Second and third stages. When the signs and symptoms announce that the tubercles are softened and cavities in the lungs formed, it will generally be necessary to modify the treatment in some degree, for the constitutional debility then commonly increases and the irritations may have diminished, or at least have not kept pace with the progress of the disorder. Here depletions are less needed, and worse borne; and a somewhat tonic plan of treatment, with some of the preparations of bark or iron if they can be borne, and more generous diet, with meat and malt liquor, may often be adopted with advantage; still counter-irritation will prove useful in most cases, and in these stages those kinds which cause a purulent or muco-purulent secretion will generally produce most benefit. In fact, the same abatement of irritation which we have before described to accompany free purulent expectoration, will in some degree follow from this external suppuration, without the wasting and harassing effect of such a discharge from the lungs. With this external outlet as a sort of safety valve, strengthening medicines and nourishment may be borne; and there is less risk in restraining any excessive secretion which may take place from the lungs, the bowels, or the skin. Much attention is necessary to keep up the artificial discharge, whether it be by the formation of successive crops of pustules, by tartar-emetic solution or ointment, or some similar suppurating liniment, or by a seton or issue. If it be suddenly checked, there will in all probability be an increase of pulmonary irritation, perhaps attended by the deposition of more tuberculous matter. In slighter cases, or where the weakness and irritability forbids these measures, occasional blisters, or the frequent use of milder liniments, containing tartar-emetic and hydriodate of potash, or diluted nitro-muriatic acid and oil of turpentine, are often productive of some benefit.

In the softened tuberculous and ulcerated stages of phthisis the constitutional powers especially need support: and it is then, more particularly even than in the first stage, that the general measures are required; but unless the disease be limi-

ted in extent, there is, for the same reason, less hope of their success. The disease has existed longer, and passed into a stage in which it is more likely to have tainted the system. The preparations of iodine and other tonic alteratives should be used more freely; and the general health supported by all the medical and hygean circumstances that can be brought to bear on it. There are vomicae to be evacuated, and the object is to assist nature in effecting this object; in protecting the lungs from farther injury during this process, and in effecting the healing of the fistulous cavities which are left. The means already recommended to strengthen the general health, are those which most conduce to these ends; but it is necessary to advert to some topical measures which have been supposed to promote greatly these objects. These are the direct application of certain gases or vapours to the lungs themselves, by means of inhalation. The only agents to which we need advert, as having been by good authority reported to be useful are chlorine, the vapour of iodine, and that of tar. The last was recommended by Sir A. Crichton. The vapour is diffused through the patient's chamber, by heating the tar to gentle ebullition, with a little carbonate of potash to retain the irritating pyroligneous acid. From the more extensive trials of Dr. Forbes, it appears that this remedy was often injurious and seldom of marked benefit in phthisis, but in bronchial disease it proved salutary. Dr. Morton of Philadelphia, and Drs. Hufeland and Neumann of Berlin, are stated by Sir J. Clark to have reported more favourably. The inhalation of chlorine was first recommended by M. Gannal, and several French physicians have spoken favourable of it. Sir C. Scudamore reports that he has effected several cures by the inhalation of chlorine with the vapour of tincture of conium or some other narcotic. Sir J. Clark states, that in several instances in which he tried it, it relieved dyspnoea and apparently suspended the progress of the disease. Our own experience of the inhalation of chlorine is not favourable; having generally found it increase the cough and other symptoms of irritation; Dr. Stokes reports to the same effect. But we should expect some benefit from it, where there is little disposition to inflammatory action, particularly when the expectoration is profuse and fetid. The vapour of iodine has also been much extolled as a means of promoting the removal of tubercles and the cicatrization of cavities; but there is not yet sufficient evidence in its favour to warrant us in recommending it. The usual modes of inhaling these vapours (through tubes adapted to a bottle containing hot water with a certain addition of the chlorine or iodine to it) have always appeared to us objectionable, inasmuch as the tubes are generally too small, and the effort of inhalation is irksome to most patients. It would be much easier to use a large open vessel of hot water, such as a basin or jar, and add to it, by degrees, the required quantity of liquid chlorine, or tincture of iodine; or place it in a saucer floating on the hot water; the patient might then approach his nostrils as near as he can bear without causing him to cough. This might be repeated twice a-day or oftener: Dr. Corrigan has devised an apparatus by which the liquid chlorine or iodine can be made to drop slowly into a vessel of water kept boiling by a lamp. He found that when iodine is diffused in this mode through the apartment of the patient for some time, it could be detected in the urine.

It is not unlikely that by very judicious management, the inhalation of various agents may sometimes conduce to a healthier and healing action in the interior of ulcerated lungs. But we must chiefly look to the improved state of the constitution for this healthy action, and for what is of more immediate moment—a cessation of that disposition to deposit more tuberculous matter in other parts, which too commonly prevails during the softening and the evacuation of tubercles.

In very many cases, alas! no means will stay the progress of consumptive disease, and the utmost that we can do is to give temporary relief to the more distressing symptoms; to the cough, sometimes by a leech or two over the wind-pipe, but more commonly by various narcotic remedies, such as conium, hyosyamus, hydrocyanic acid, and particularly opiates, of which the compound camphor tincture, and Squire's solution of bimeconate of morphia in small doses, we have

found the best; to pains in the side, by a mustard poultice, a turpentine fomentation, and if these fail, by a few leeches or a blister; to the dyspnoea, by æther and ammonia, or paregoric, or tincture of lobelia, or, according to Sir J. Clark, by extract of stramonium, half a grain in the day; to the hectic heats, by sponging with tepid vinegar; to the sweats and to excessive expectoration, by acid and tonic mixtures; to the diarrhoea, by astringents, preceded by a mercurial aperient, and accompanied by a suitable diet. In not a very small number of cases we may considerably prolong life by watchfulness and judicious measures. Consumption may run its course in a few weeks; but it may exist in a limited and chronic form for many years, and such cases may reward us for our attention and judicious treatment, if not by permanent recovery, at least by temporary restoration of a moderate share of health and strength, compatibly with the enjoyment of life, and with the fulfilment of important duties in society.

Prevention of tuberculous disease. The small chance of doing good which the healing art possesses in tuberculous disease is a great reason why our attention should be directed to measures of prevention from which much benefit may reasonably be expected; and it is on this department of practice that our improved knowledge of the pathology may be brought to bear. The prevention or speedy removal of those inflammations and congestions which contribute to develop phthisical lesions, and of that state of strumous cachexia, or imperfect nutrition, from which they especially arise, constitute the indications for prevention which pathology suggests. To fulfil these indications is to remove or counteract the several causes which we have specified as producing or increasing consumptive disease, and the means of effecting this, comprehend many remedial and hygeianic details. It is only necessary here to advert to some of the more prominent.

The earliest and at the same time the least doubtful cause of phthisis is hereditary predisposition; and when this has been fully acquired, either this or some other form of scrofulous disease generally ensues sooner or later. But it is very probable, as Sir J. Clark has suggested, that the formation of this predisposition could be in great degree prevented by attention to the health and alliances of successive generations. "If," says he, "a more healthy and natural mode of living were adopted by persons in that rank of life which gives them the power of choice, and if more consideration were bestowed on matrimonial alliances, the disease which is so often entailed on their offspring might not only be prevented, but even the predisposition to it extinguished in their families, in the course of a few generations."

The propriety of avoiding intermarriage with those families which have shown proofs of consumption is obvious, as nothing is more likely to increase the tendency. The health of mothers during utero-gestation and suckling should also be carefully guarded; and the children of consumptive families must be reared from birth to maturity with the fullest possible regard to their physical condition, and every precaution against causes of disease and derangement of the general health. Warm clothing, well-ventilated rooms, a healthy residence, plain nutritious food, but of due quantity and quality, regular and frequent but varied exercise in the open air, as far as the season will permit—that on horseback is the best; daily use of the cold bath, or free sponging, followed by friction; strict attention to the state of the excretions, and their regulation, if necessary, by diet and mild remedies, constitute the chief general means to be employed to fortify the constitutions of those in whom there is reason to suspect a disposition to phthisis. Frequent change of air, particularly from inland to coast and the converse, is generally beneficial, as far as that can be practised without incurring exposure to an unhealthy or too cold an atmosphere. Occasional sea voyages are sometimes of marked benefit in generally strengthening the constitution. A residence for some years in a warm climate is indicated for those whose brothers or sisters have become consumptive in this country about a particular age; but on their return, even although the critical period be passed, unusual care will be necessary for some time. So, on the other hand, those who become enervated and languid during the heat

of summer, should resort to a mountainous district or an airy coast during that period. The great object is to prevent the general strength from being lowered, or the functions deranged, by any influence whatsoever, and this is generally better to effected by hygeian than by medicinal means, but we may and often must bring our aid tonics and alteratives of various kinds, as well as the different remedies that are required to improve the secretions. It is impossible to enter into any details, for very different remedies may be best suited to different individuals; but if there be any which are so more commonly than others, these are combinations of iodine and of iron, and courses of saline or saline chalybeate mineral waters. With the view to strengthen the lungs, and to render the pulmonary system less apt to suffer from cold or heat, the regular practice of freely sponging the chest and whole trunk with vinegar and water, or salt and water, followed by vigorous friction, deserves especially to be recommended. It not only improves the tone of the respiratory apparatus, but diminishes the liability to bronchial affections from exposure to cold: these affections are the most common causes of the development of tubercles.

MALIGNANT GROWTHS IN THE LUNGS.

Encephaloid disease of the lung.—Scirrhus.—Melanosis and spurious Melanosis.

WE need say little on the subject of encephaloid, scirrhus, and melanose disease of the lungs; for their occurrence is too rare to be of much practical importance, and they are not known to be influenced by medicine. They may occur in a circumscribed form, or pervading a considerable extent of the pulmonary tissue; and they would then produce physical signs like those of consolidation from hepatisation or tuberculation of similar extent, and could be distinguished from these only by the history and general symptoms, and by the absence of the constitutional indications of tubercles. They commonly cause death, either by their encroachment on the function of the lungs, or from being simultaneously deposited in other organs, such as the mesentery, the liver, the ovaries, &c. But when they occupy the lung chiefly, both encephaloid and melanose deposits tend in time to soften and form ulcerous cavities as in the case of tubercle. We have seen such cavities more than once in both these forms of disease.

The general appearance of *encephaloid disease* or *medullary sarcoma*, is that of a brain-white solid, of varying consistence, with a pinker hue than that of tubercle, occurring either in separate tumours, which are sometimes encysted, or infiltrated through the tissues of the lung, and modified by their colours. When occurring in separate tumours, it is sometimes soft and cellular; in other cases tougher, and more like the pancreas; in others, again, it becomes of fibro-cartilaginous hardness. A predominance of a loose cellular and vascular structure in it, with patches of extravasated blood, give it occasionally the appearance that has obtained for it the name of fungus hæmatodes. We may conjecture that the albuminous matrix of these products is deposited in an organizable form, and vascular ramifications are certainly formed through it; but it is deficient in the cohesion and contractile tendency of ordinary false membranes; it does not restrain the farther effusion from the vessels, whence the tendency to growth in these productions. When encephaloid matter occurs in an infiltrated form in the tissue of the lung, it sometimes presents an appearance intermediate between that of tuberculous and that of hepatised consolidations; and unless there be portions of the diseased production occurring separately, it might be taken for one or other of these lesions.

The only form of disease which we have seen affecting the lung, which approaches in any degree to *scirrhus*, is that which we have already described as a result of a chronic pleuro-pneumonia; there being in these cases firm adhesions to the pleura, a shrunk state of the lung, and dilatation of the bronchial tubes. The induration and glistening texture which the lung so changed sometimes exhibits, especially around the larger air-tubes, might lead one to suspect it to be of a scirrhous nature; but we have seen neither the tendency to cancerous ulceration, nor the simultaneous occurrence of scirrhus in other parts, which might be expected if this induration of the lung were really of a malignant kind. Dr. Corrigan seems to have lately described a similar morbid condition, which he calls, not very appropriately, cirrhosis of the lung.

We have met with several cases of *melanosis*, or *black tubercle*, affecting the lung, both exclusively, and with the same production in other parts of the system. We have seen it combined with encephaloid disease. The black matter may occur infiltrated in a natural structure, or in distinct tumours or deposits of an irregular cellular organization. We are much inclined to adopt the opinion of Andral, that the black matter is nothing but a modification of the colouring matter of the blood, in which carbon is in excess, or even in a free state. We have seen the deposits exhibit in different parts various shades of colour, from the dark cruor red of hæmorrhagic engorgement to the deep jet black of perfect melanosis. The intermediate colours were of a bistre or sepia brown. The organized texture of melanose tubercles and tumours presents considerable variety, sometimes approaching to the most perfect products of acute inflammation, being soft and cellular or membranous; and sometimes having almost the totally unorganized structure of scrofulous tubercle. Probably it is only this latter form that undergoes the changes of softening and ulceration ascribed to melanosis by Laennec; and under these circumstances, such changes are to be referred to the same causes as those which operate in the kindred changes of tubercle. The presence and modification of the colouring matter of the blood seems, therefore, to be the essential pathological condition of this disease, as an altered or deficient vitality of the fibrinous matter is of tuberculous affections.

It is necessary to avoid confounding with melanosis the accumulations of the black pulmonary matter, which take place to a great extent in the lungs of old people, especially among the inhabitants of large towns. These are probably, as Dr. Pearson supposed, derived from the soot inhaled with the air; which, we presume, finds access to the texture of the lungs chiefly through abrasions, softening, or other such lesions of the bronchial membrane, which, in a slight degree, often result from a common cold or cough. Whether from this source, or, as others have supposed, from an altered state of the colouring matter of the blood itself, we think it is plain enough, that when once deposited in any corners out of the immediate sweep of the circulation, such as in the angles of lobules, near old lesions, around large vessels, and in the bronchial glands, there it must lie, accumulating until death, or until it is carried off by the destruction of the tissue by some pulmonary disease. For it consists entirely of carbon; and this being totally insoluble in any animal fluid, is insusceptible of absorption, which scarcely acts on insoluble solid matter. For the same reason the carbonaceous matter of tattooed skins, and the insoluble oxide or chloride of silver in persons coloured blue from the too long internal use of nitrate of silver, are permanent, and can only be removed with the skin itself. It does not appear that this carbonaceous deposit in general interferes materially with the function of the lungs; but there are some curious cases on record, in which it has taken place so rapidly and extensively as to cause chronic inflammation and consolidation of a perfectly black colour, which tends to ulceration and the formation of cavities, as in other cases of chronic consolidations. Such cases are described by Drs. Gregory, W. Thomson, and others, as occurring particularly in coal-mines, and persons labouring under bronchial disease whilst continually employed by the light of smoky lamps.

The general symptoms of encaphaloid or melanotic consolidation of the lungs are those of obstructed breathing or circulation, dyspnœa, lividity, and dropsy; more commonly than those of consumption and emaciation, which belong rather to tuberculous disease. This is explained by their more rapid development, and their not so readily leading to softening and ulcerative destruction of the organ. When this process does occur, the expectorated matter may afford means of distinction. We have seen, in the case of encephaloid disease, streaky red and white purilaginous liquid sputa, and, in melanosis, a considerable quantity of black matter, mixed with a muco-purulent compound. But such cases are not common, and the expectoration is more usually that of the bronchitis or pneumonia that may accompany the disease.

DISEASES OF THE BRONCHIAL GLANDS.

THE *bronchial glands* are not unfrequently found after death in a diseased state, even when no symptoms referrible to them had been manifested during life. We do not mean the deposite of black matter like that of the lungs, for that is so constant that it can scarcely be considered to be morbid. But they are sometimes found swollen and red, or containing caseous matter, or osseous concretions. In children they are occasionally so enlarged by the deposition of tuberculous matter, as to press on the air and blood-vessels, and, according to Dr. Carswell, to produce dyspnœa and symptoms of obstructed circulation. They sometimes soften, and become evacuated by ulceration into the bronchi. Encephaloid disease, as well as extensive enlargement, not of a malignant character, may also affect these glands. We suspect that encephaloid disease of the lungs generally originates in this way, and spreads afterwards along the vessels into the pulmonary tissues. We have also met with cases of dulness on percussion on the top of the sternum, with signs of obstructed circulation and respiration, with simultaneous enlargement of the axillary and cervical glands, betokening a glandular tumour about the root of the lungs; and all these symptoms gradually subsided under the use of iodine and alkalies; so we conclude that the tumour was simple glandular enlargement. Considerable tumours of the bronchial glands might perhaps sometimes be discovered by dulness on percussion on the upper portion of the space between the clavicles, and on the spinous processes of the upper dorsal vertebræ. The tumours generally, however, grow forwards, and we have seen them pushing out the sternum or the ribs on one side, and causing dulness at those parts, and symptoms of displacement of the lung farther down. They also may produce signs by their pressure on the great vessels, arterial and venous, stimulating those of aortic aneurism; and we have known them compress the great bronchi to a fatal extent.

The tuberculous disease of the bronchial glands is almost confined to children, and is in them the most frequent form of tuberculous deposite. It complicates, therefore, almost all disorders of this kind, and is the point which is in most cases first attacked. The glands do not, as a general rule, pass into softening. In the largest number of cases the tuberculous matter becomes hard and dry, and is finally converted into a calcareous deposite which is absorbed with great difficulty, and sometimes remains ever afterwards. In the smaller number of cases, softening actually occurs, and the contents of the cyst which contained the gland are evacuated through an ulcerated opening into the bronchi.

There are no positive signs of tubercles in the bronchial glands, but if they attain a tolerable size, sufficient to press upon the tubes and diminish their caliber, the patient frequently has attacks of spasmodic catarrh similar in many respects to those of pertussis, but less violent: if these are conjoined with the general signs of a scrofulous diathesis, the diagnosis becomes tolerably certain. The treatment is of course entirely constitutional: iodine and its various preparations, and other remedies which act as general alteratives, are the only means from which much can be expected in this form of scrofulous disease. G.

INFLUENZA.

Nomenclature.—Description.—History of the principal visitations.—Diagnosis.—Nature of the disease.—Source of the epidemic.—Treatment.

THE malady to which, from the supposed influence of the stars in its production, the name of *influenza* has been applied, is an epidemic affection, usually accompanied with catarrhal symptoms, and with a depression of strength far greater than is proportionate either to the febrile excitement, or to any accompanying local disorder. It is the *Rheuma epidemicum* of Sauvages, the *Catarrhus epidemicus* of Swediaur, *Catarrhus à contagio* of Cullen, *Amphimerina anginosa* of Huxham, *Febris remittens catarrhalis* of Macbride. By the French writers it is called *Folette*, *Coqueluche*, *Petite poste*, *Coquette*, *Baraguette*, *Rhume épéémique* [and Grippe,] *Fièvre catarrhale*; by the Italians, *Catarro Russo*; by the Spanish, *Influenza Rusa*; by the Germans, *Huhnerzipf*, *der Hühner Wenn Bletzkarr*, *Epidemischer Schnupfen*, *Russische Krankheit*.

Of all epidemics it is the most rapid in progress, sudden in invasion, and extensive in range. The complaint usually commences like a feverish attack, with a feeling of chilliness and a sensation as of cold water running down the back; weariness and stiffness of the limbs, and pain in the neck, back, and loins, more intense than those which attend the common forms of fever. In the more severe cases there is decided rigour alternating with heat and flushing of skin; the fever has an exacerbation every evening, and lasts from two to fourteen days: pain is felt over the frontal sinuses and cheek-bones, or behind the sternum. The eyes are suffused; there is sneezing, tingling, and an acrid discharge from the nostrils; a short, frequent, harassing cough; a feeling of constriction of the chest and throat, and not unfrequently soreness, redness, and tenderness of the fauces. The inflammation of the tonsils is occasionally intermittent. The expectoration, at first scanty and difficult, consisting of thick viscid mucus, usually devoid of air-bubbles, subsequently becomes opaque, copious, and muco-purulent. Sonorous, mucous, and sibilous rhonchi may be detected by auscultation, and there is frequently partial crepitation, which is most apt to occur at the lower portion of the lungs. The circulating system is depressed, the pulse being usually feeble, soft, and quick in the early stages; in the decline of the disease slow and sometimes intermitting. The appetite is impaired and the taste perverted; nausea and vomiting are often present; the tongue white and moist, covered with a creamy mucus, or loaded with a coating of moist yellowish fur, and presenting elevated papillæ of a peculiar vivid red colour at the edges: in some severe cases it is, however, little affected. In most instances the urine is scanty and high-coloured, soon becoming thick and reddish, or assuming a whey-like appearance, and depositing a copious pink or whitish sediment. The depression of strength is extreme, occasionally resembling the collapse of cholera; the moral energy is subdued, and agonizing fears of death are sometimes present. The skin, at first hot and dry, soon becomes perspiring, and often exhales a peculiar, flat, musty smell; some-

times it assumes a bluish hue. When the lungs are not materially affected, the force of the morbid influence is in some instances directed to the bowels, producing pain and tenderness of abdomen, and diarrhœa, with mucous or dysenteric evacuations; at other times, the brain being chiefly involved, vertigo, sleeplessness, and delirium, are prominent symptoms. In very old and debilitated subjects, the disorder often presents the character of suffocative catarrh. Among the most characteristic phenomena may be mentioned the persistence of cough and debility, long after the cessation of the other symptoms.

The most frequent and important complications are, inflammation of the bronchial tubes, lungs, pleura, or of the brain and its membranes, acute articular rheumatism, neuralgia, and cutaneous eruptions. The nature of the complication occasionally depends on constitutional peculiarities, but frequently on exposure to the exciting causes of the associated diseased action, about the time of the onset of the attack of influenza. Thus, for example, exposure to damp under such circumstances will occasion a liability to rheumatic complications, and fatigue or mental anxiety to erysipelas. The principal varieties of the complaint depend partly on atmospheric conditions, partly on the predispositions of the persons affected: they may be divided into, 1. The cerebral, characterized by vertigo, delirium, erysipelatous eruption on the face, sometimes swelling of the parotid glands. 2. Guttural, attended with Cynanche tonsillaris. 3. Bronchial, with difficult oppressed respiration: this variety, when occurring in its severe form, constitutes suffocative catarrh. 4. Intestinal, with diarrhœa, mucous evacuations, and in some examples tenderness of abdomen. 5. Typhoid: this form, which rarely occurs except among the poor and badly nourished, is characterized by depression of pulse, extreme prostration of strength, and other symptoms of putrid or adynamic fever. One of the most important considerations connected with the subject of influenza is the tendency of the disease to alter the condition and increase the susceptibility to disordered action of the nervous system and of the mucous membranes. A succession of attacks more commonly occurs in this than in any other febrile disorder; and the part to which the force of the disease has been most directed, remains peculiarly susceptible of derangement: thus a liability to chronic bronchitis, to intestinal irritation, and to rheumatic and neuralgic affections, often remains for years after a severe attack of the malady; and the subjects of such complications appear less tolerant of active remedies. Almost every visitation of influenza, although characterized by the predominance of some one variety, generally presents examples of each, besides, in some instances, exhibiting phenomena peculiar to itself. The various features of the disorder will therefore be best exhibited by a review of the most remarkable examples related by authors.

History. Hippocrates and other ancient authors give slight notices of catarrh resembling the disease under consideration. In latter times the epidemics of 1311, 1323, 1327, 1387, 1400, 1403, 1410, 1414, 1427, 1438, 1482, and 1505, were probably examples of the same affection.

That of 1323 prevailed throughout the whole of Italy, and, according to Buoni Segni, was attributed to a pestilential wind. In 1387 the disorder prevailed at Montpellier and Romagne, and is said by Valesco to have attacked nine-tenths of the population. In 1403, according to Pasquier, a catarrhal visitation occurred at Paris, so severe as to render it necessary to suspend the assizes. The epidemic of 1410, described by Valesco, was characterized by harassing cough, which was regarded as a punishment for singing a licentious song. The visitations of 1414 and 1448 were peculiarly destructive to the aged. Although the short notices now extant of the above epidemics render it extremely probable that they were examples of the disease in question, yet the first instance which we are fully authorized to refer to it, and the first accurately described by medical authors, is that which occurred in the year 1510, and proved fatal to Ann, wife of Philip of Spain. According to Schenck, it was regarded as a new disease. The epidemic proceeding in a north-westerly direction from Malta to Sicily, Spain, Italy, France, and Britain, raged over all Europe, and scarcely missed an individual, but few died except

children. The complaint was attended with violent pain over the eye, and with the usual symptoms of more recent attacks. Delirium and gastrodynia were often present, and in some instances, from the seventh to the eleventh day of the attack, snatching of the tendons and syncope occurred. Diarrhœa, or sweating, were common at the decline. It was a frequent practice to apply five blisters, two to the legs, two to the arms, and one to the back of the head. Bleeding and purging are said to have been injurious. A similar disorder prevailed in the autumn of 1557, after a hot dry summer followed by cold northerly winds. The malady was in some places preceded by ill-smelling fogs, and followed by great inundations. The disease took a westerly course from Asia by Constantinople to Europe, and afterwards visited America. The attendant fever, according to Mercatus, exhibited the character of a double tertian. This epidemic was more destructive than that of 1510; 200 persons fell victims to it at Alkmaer in Holland, and 2000 in the small town of Mantua Carpentaria. In the latter instance the mortality was attributed to the employment of bleeding; but many persons of opulence perished under the suspicion of being poisoned. A similar mortality attended the epidemic catarrh of 1580: 9000 died of the disease at Rome, according to Wierus, in consequence of bleeding. The course of the affection was from east and south to west and north. It raged in France after a cold dry wind, following long continued warm moist weather. A prodigious number of insects covered the roads in France about the time of its appearance. In many places it was observed that animals accustomed to feed on herbs and leaves, took a dislike to their pastures. Birds of passage migrated before the usual time, and those that sleep in low valleys repaired at night to higher districts. (*Salvus Diversus de Febre pestilentiali.*) The disorder raged at Sicily in June, at Rome in July; proceeded by Venice and Constantinople to Hungary and Germany, thence to Norway, Denmark, Sweden, and Russia, where it prevailed in December. Although the plague proved very destructive during this year at Cairo, it is remarkable that no European country was visited by that disorder except France, which had been the first to suffer from the catarrhal epidemic.

Bleeding from the nose frequently occurred during this epidemic, but the most characteristic symptoms were vigilance or somnolency, giddiness, resembling that of intoxication, and swelling of the parotid glands. Riverius and Forestus, contrary to the observation of Wierus, speak of bleeding as an important part of the treatment. Sixty thousand persons are reported to have died at Rome in the years 1590 and 1591 of a similar epidemic, associated with severe cerebral symptoms. Another visitation occurred suddenly in April, 1568, and was chiefly prevalent in England, after great extremes of weather: the following summer was exceedingly hot, and a fatal epidemic fever prevailed at its close. In 1663 it is said that 60,000 persons were attacked with influenza in the Venetian states in one week. The disease was attributed by Paulini to an intense fog which came from the Adriatic. In 1669 a similar affection prevailed in Holland, and proved fatal to Sylvius de la Bœe. In 1675 Germany was visited in September, and England in October, by a similar epidemic: the previous summer had been unusually warm, and followed by cold moist weather. It is worthy of notice, that the plague prevailed that year in Malta, although it did not visit that place afterwards till 1813. This epidemic was preceded in France by thick fogs. The disease is said by Peu to have been peculiarly fatal to women in the puerperal state. The influenza which prevailed throughout all Europe in 1729 and 1730 was attributed by Hoffmann to changes of weather from heat to cold, and cold to heat, greater than he had ever experienced; by Lœu it was referred to thick sulphurous fogs. Several earthquakes occurred about the same time, and he considered these, as well as the sulphurous transpiration, to be occasioned by the non-occurrence of an eruption of Vesuvius. This catarrhal fever visited every part of Europe in the course of five months, and attacked 50,000 persons at Milan, 60,000 at Rome, and the same number at Vienna. It was very fatal in Paris and London: in the latter place destroying a thousand a-week, in September, a greater

number of deaths than had occurred in this city in so short a time since the period of the plague. Switzerland suffered little, Italy and Spain very considerably. The disorder generally proved most severe in low marshy situations. In some places it was complicated with petechiæ. Hysterical subjects when suffering from the epidemic, complained of a peculiar feeling of cold in the course of the sagittal suture. Sanguineous discharges frequently occurred at the termination of the disease, and bleeding was in many instances employed with advantage.

The influences on which catarrhal epidemics depend appear to have continued in operation from the year 1732 to 1737, and they were associated with remarkable electrical and telluric phenomena. During the spring and autumn of 1732 the weather was unusually dry; the aurora borealis was often peculiarly vivid; volcanic eruptions occurred in various parts of the world; south winds were attended with a dry, and those from the north with a rainy, state of the atmosphere. The disorder is said by Huxham to have ceased suddenly after the explosion of a meteor in the air, which was accompanied with a fetid fog, and produced, for an hour, an appearance as though the north of the heavens was on fire.

It was observed that the epidemic was most apt to be complicated with pectoral affections about the time of the equinoxes, and that cough was generally relieved by diarrhœa, whether occurring spontaneously or produced by purgative medicine. In the autumn of 1732 the disorder overran Europe and visited America. In Britain its course was southerly; it appeared at Edinburgh in November, and did not reach Cornwall till February in the following year. From New England in America it spread southward to Jamaica, Peru, and Mexico. This epidemic affected the intestinal as well as the respiratory system; sanguineous discharges from the nose, lungs, and bowels were frequent, especially when bleeding was omitted. Swelling of the parotid and salivary glands, and of the testes, was occasionally observed. In Edinburgh the poor and those most exposed to atmospheric vicissitudes suffered most. The inmates of the prison and of Heriot's hospital entirely escaped the malady, and although the interments at the Grayfriar's Burial-ground were twice the usual number in the month of January, 1733, yet the fees from the opulent classes did not exceed the common average. Before the eruption of the disease, cough prevailed extensively among horses. The years 1741 and 1742 were remarkable for atmospheric vicissitudes, frequent appearances of the aurora borealis and of meteors resembling soldiers fighting in the air. Catarrhal fever visited several countries during the years 1741 and 1742; and in the spring of 1743, after five months of excessively severe weather with easterly winds, prevailed generally in Europe under the name of *La grippe*, a word probably derived from *chrypka*, the Polish word for hoarseness. Destructive disease existed at the same time among horses and deer. The influenza commenced with lassitude and shivering, cold hands and feet, pains of head, limbs, and spine, inflamed eyes, loss of taste and appetite. There was a remission of fever at four or five in the evening, and an exacerbation at night. The decline of the disorder was sometimes accompanied with diarrhœa, at other times with an eruption of pustules on the skin. Sauvages describes a hissing noise occurring in the cough of old people affected with the complaint, many of whom died on the ninth or eleventh day. This epidemic preceded the plague in some parts of Sicily. It was less fatal throughout England than in other countries; nevertheless a thousand died of it during one week in London. Epistaxis was a frequent symptom, and in young plethoric subjects bleeding was found useful, and according to Sauvages, might be repeated with advantage; but Sennertus attributes the destructiveness of the disease at Rome to the injudicious employment of that measure.

The spring of 1762 was characterized by remarkable alternations of intense heat and cold, and by a rapid succession of wind, frost, snow, and rain; and epidemic catarrh was general in Europe. It had however appeared during the previous year in America. The disorder swept away one-third of the inhabitants of Toulon, extended northwards to Breslau, Vienna, and Hamburg, and in a month

passed from London to Edinburgh. This epidemic was singularly capricious in its course and severity, destroying a hundred daily at Breslau, yet sparing Paris and the greater part of France; it was exceedingly mild in many parts of England, especially London, the suburbs of which escaped, but in Norwich was more fatal than the visitation of 1743. It prevailed among the sailors in the Mediterranean in July, during the prevalence of hot weather with easterly winds. Those who were severely attacked usually had either head symptoms, or harassing cough. These symptoms sometimes alternated with each other, but scarcely ever existed together. At the end of the second week at Edinburgh, some of those affected complained of pains of the thigh, others had maniacal attacks. A large proportion of the inhabitants of Europe suffered from the complaint; but scarcely any died, except the old, the asthmatic, and the consumptive. Relapses were frequent, and those who neglected themselves had a tedious cough with some degree of fever, which occasionally was intermittent, and yielded to bark.

The autumn of 1775 appears to have been remarkable, both in France and Britain, for thick noisome fogs, so prolonged as to obscure the sun for many weeks. In France the weather was cold and rainy, in Scotland unusually dry. The commencement of the year was very cold, then followed snow, abundant rain, and sudden changes of temperature. These vicissitudes occurred later in England than on the Continent, in correspondence with the later appearance of the epidemic. Disease prevailed at the same time among dogs and horses: meat suspended in the air by means of a kite, near Glasgow, quickly became tainted. Dr. Fothergill, with laudable zeal, engaged in a correspondence with various practitioners on the subject of the epidemic, and much valuable information was thus obtained respecting the local peculiarities of the complaint. This visitation was mild in its character, especially in England; and most of the deaths which occurred were attributed by Dr. Macbride to the omission of bleeding. More men than women suffered, and, with the exception of Dr. Ash of Birmingham, most observers agree, that those who were most exposed to the weather, were most liable to the attack. Sir George Baker remarks, that girls' schools frequently escaped, whilst boys' schools were often severely affected. The complaint was attended with pain in the loins and sides, and occasionally with cramps; there was frequently itching of the skin; in some instances an eruption of pustules, in others crysipelatous redness; and Dr. Heberden saw two cases in which there was a rash resembling scarlatina. Suppuration of the parotid glands occasionally occurred, and a tendency to somnolency was sometimes present. Dr. Thompson of Worcester in some instances observed an alternation of delirium, stupor, and cough. Dr. Haygarth in one case remarked the following symptoms in succession,—diarrhœa, delirium, cough, and an exanthematous eruption; subsequently the cough returned, and continued as the prominent symptom till the disease subsided. The average duration of the complaint was five or six days. Dr. Fothergill mentions that those patients soon recovered, who, within thirty-six hours after the onset of the disease, had a free discharge from the nose, copious expectoration, perspiration, or bilious evacuations. Sir George Baker notices a milky appearance of the urine as an indication of recovery. The decline of the disease was attended with a febrile condition, which was often intermittent. This state on the Continent was relieved by bark, but in England that medicine only aggravated the fever, and purgatives were found requisite. Several peculiarities of a local character deserve to be noticed. In many places bleeding was found useful, but Dr. Ash of Birmingham mentions that none died in the workhouse of that town except those that were bled. In some districts the disorder was partial, in others general. Thus, for example, at Exeter, of 173 persons in the hospital only two children escaped; and at Chester all the inmates of the house of industry, amounting in number to 175, suffered from the malady. At York, the inhabitants of which are peculiarly prone to constipation, the disease was usually combined with diarrhœa. At Aberdeen the attendant fever never assumed the intermittent character. Dr. Fothergill observes

that the blood taken from patients under the complaint was uniformly sizy; the size being rarely cup-like, but resembling a flat cake of yellowish tallow, floating on deep yellow serum: this observation, however, is not confirmed by other observers. The epidemic is said to have ceased suddenly on the setting in of a frost.

The influenza which raged in England in the spring of 1782 appears to have travelled from the east. It was termed *Bletzkarr*, from the suddenness of its invasion. In September, 1780, the crew of the *Atlas*, East Indiaman, suffered from the malady on their course from Malacca to Canton. Although no instances of the disease had occurred at the former place, they found, on arriving at Canton, that it had raged there associated with bilious complaints, which attended it also in October, 1781, on the Coromandal coast and in Bengal. In November, 1781, the epidemic attacked the army besieging Negapatam; it prevailed at Astrachan, Tobolski, and Moscow, in December; Petersburg in January, 1782; and Strasbourg in February; spreading through Denmark and Holland (where it received the designation of *Morbus Russicus*) in March, it arrived in England at the end of April, making its first appearance at Newcastle-on-Tyne. This epidemic attacked three-fourths of the population. It was observed to visit towns before villages, and villages sooner than detached houses. It took three weeks to pass from Edinburgh to Musselburgh, which lies five miles to the south-east. The most prominent symptoms were, loss of smell and taste, feeling of contusion in the limbs, darting pain and sense of constriction in the forehead and temples, and sometimes of the whole face, with soreness under the muscles of the cheek-bones. This last symptom sometimes occurred without catarrh, at other times preceded it. Languor, dejection, and depression of spirits, were always present in a high degree, and even in the milder cases the countenance was much altered. There was considerable constriction of chest, dyspnœa, and generally cough, which produced much pain behind the sternum, and aggravated the suffering in the frontal sinuses. In some instances pain in the chest and sides are constituted the only symptom. When the catarrh was slight, the disorder had more the appearance of an attack of fever, at first intermittent, and afterwards marked by a quotidian exacerbation like continued fever, and attended with cough, and pain of chest and head: in these cases bark was found useful. Dr. Haygarth considered the disorder contagious. In the plethoric, delirium frequently occurred, particularly at night. Bleeding was not generally found expedient. As in other visitations of influenza, six weeks was the average continuance in each place, and those most exposed to the weather suffered most from its influence.

As respects the relation of this epidemic to meteorological conditions, we may mention, that the summer of 1781 was excessively hot and dry, no rain falling in England from the middle of June to the middle of September; the autumn was cold and damp, and the winter changeable. The spring of 1782 was remarkably late, the hedges in some parts of England not being full blown till June. In May the weather throughout Europe was singularly disturbed, gloomy, cold, and humid. Dr. Darwin observes that the sun was for many weeks obscured by a dry fog, and appeared red as through a common mist. In Bedfordshire, according to Dr. Hamilton, the temperature of the 22d of May was one degree lower than that of the 22d of the previous December. On the 2d of January the thermometer at St. Petersburg rose during the night from five degrees below to thirty above zero, and in the morning, in that city alone, 40,000 persons were affected with influenza. For three months previously to the occurrence of the epidemic, in the midland counties of England, scarcely a day had passed without rain; and the outbreak of the disorder was preceded by thunder-storms presenting remarkable phenomena:—"The lightning consisting of balls, which struck against each other, and threw out sparks; and although the thunder was distant, houses were burnt, trees shattered, and several persons killed." It must however be acknowledged, that remarkable variations of temperature during the prevalence of the

disorder did not appear materially to influence the severity or frequency of the attacks.

The influenza of 1803, which was nearly as extensive as that of 1775, advanced in a northerly direction. Several solitary cases occurred previously, but the disease did not prevail as an epidemic in England till February, when it appeared in Sussex; it entered Nottingham in March, Yorkshire in April, and Durham in May. France and Holland suffered before England. Northeasterly winds, thick, fœtid, acrid fogs, vivid appearances of the aurora borealis, and sudden atmospheric changes, had been previously observed, and in some countries shocks of earthquakes were experienced. In England the fields were covered with immense numbers of insects, and disease prevailed among horses, cows, sheep, swine, dogs, and cats. In France the disorder was often followed by ophthalmia, and in America by dysentery; many children who were the subjects of the complaint had dilated pupils, itching of the nose, and anus, and mucous evacuations containing worms. Pneumonia was also a frequent complication, and bleeding was often found necessary. In some subjects dimness of vision attended the complaint, and remained even after the recovery of strength. One patient, for four days, saw objects three times multiplied. In this epidemic those who lived in sheltered situations, as in prisons and infirmaries, frequently remained free from the disease. The boarders in schools often escaped, provided they were not exposed to the north. One of the most striking instances of the influence of exposure is related by Dr. M'Can of Armagh, who mentions, that of 400 soldiers in barracks only eight were affected, while a large proportion of those billeted in the country suffered severely. Many interesting particulars of this epidemic are recorded in the account published by the London Medical Society. Dr. Fothergill, who wrote an excellent account of this visitation, considered the malady contagious.

In September, 1830, the disease again appeared at Manilla; it attacked some parts of Britain in the spring of 1831, but did not reach others till the autumn. Remarkably thick fogs, and great variations of weather, had been observed for some months previous to its appearance. This epidemic was widely diffused, prevailing both in the East and in America. In Warsaw, as well as in many parts of Britain, it preceded the epidemic cholera. The characteristic symptoms were, tenderness of the scalp, and cramps of the legs and arms. Towards the subsidence of the epidemic, diarrhœa, and dysentery occurred, and formed a transition to cholera. Cough and debility continued long afterwards.

In 1833 the epidemic cholera was followed by influenza, which made its first appearance at Java, and attacked more than the influenza of 1831. It was more acute, and left less cough than the ordinary visitations of the malady. The distinguishing symptom was severe headach. Those who died generally had cerebral symptoms at an early period. According to Dr. Fife, of New-castle, bleeding was generally found injurious.

The influenza, as it occurred in England in 1836-7, is fully described in the *Trans. of Prov. Med. Assoc.*, vol. vi. that society having made laudable efforts to obtain information respecting the complaint, from all parts of the country. The weather prior to the occurrence of the disorder had been extremely unsettled. From the 22d to the 25th of December, 1836, there was a fall of temperature of twenty-five degrees, and a quantity of snow followed, perhaps unexampled in this country. Snow fell also in Palermo, Lisbon and Canton. On the 2d of January a thaw set in, and thick fogs prevailed during the month; the general outbreak of the disorder occurred at the commencement of the thaw: easterly winds prevailed, and the aurora borealis was frequently visible: a great many dead flies were found on the surface of ponds. It is remarkable that the malady existed simultaneously at Sidney and the Cape of Good Hope, and on the shores of the Baltic. Half the population were attacked in London, Hamburg, and Copenhagen.

The symptoms for the most part corresponded with those described at the commencement of this article as generally characterizing influenza, particularly

feverishness, pain and weight of forehead, tingling and acrid discharge from the nostrils, soreness of the fauces, hoarseness, cough, dyspnoea, far exceeding the degree of attendant inflammation, and great general depression. In some parts of the country, particularly at Salisbury and Aylesbury, rheumatism, neuralgia, and rheumatic neuralgia, were frequent complications. In some cases inflammation of the membranes of the brain occurred, in others inflammation of the spinal cord. Pneumonia was a frequent accompaniment, and when it was relieved by bleeding, the original disorder pursued its usual course. The head was in some patients attacked with pain, resembling neuralgia of the branches of the fifth pair of nerves. The pain was remittent, never distinctly intermittent, and sometimes yielded to arsenic. Spontaneous pytalism occasionally occurred. Dr. Fife and a few other practitioners mention, as an occasional occurrence, enlargement of the parotid glands. From an interesting statement by Dr. Clendinning (*Med. Gaz.*, vol. xix.) it appears that of 157 complicated cases (constituting three-fifths of those recorded by that accurate physician,) 36 had pneumonia, 52 bronchitis, 25 phthisis, 25 fever, 5 pleuritis, and 14 suffered from other affections. Of 40 severe cases related by Dr. Macleod, 3 had laryngitis, 3 pleuritis, 4 otitis with purulent discharge, 4 inflammation of the fauces, 2 swelling of the parotid and sub-maxillary glands, 1 inflammation of the conjunctiva, and 3 had erysipelas on the subsidence of the other symptoms. The membranes of the eyes were less frequently affected in this epidemic than in that of 1833. Some patients were seized with sudden insensibility; many were affected with agonizing fears of death. Syncope was produced by the removal of a small quantity of blood, and in some instances occurred spontaneously. A state of collapse, resembling that of cholera, was occasionally observed. Relapses were frequent, requiring more active treatment than the primary attack, and often attended with violent pain between the umbilicus and symphysis pubis. It was observed that children suffered much less severely than adults, excepting during the period of dentition. The victims to the disease among elderly persons had been for the most part previously subjects of bronchitis, or disease of the heart; and, among the middle-aged, of phthisis. The fatality of the complaint was also considerable among those affected with asthma or pertussis, or who had just recovered from eruptive diseases. The deaths, as far as could be ascertained, were about two per cent. on the number attacked, a proportion corresponding with that deduced by Ozanam from a calculation of the mortality of all the recorded instances of epidemic catarrh. During the epidemic of 1836 it was generally thought, that free exposure to the weather lessened the liability to the disease.

We may deduce from the preceding account that, since medical records have become available, influenza has prevailed on an average once in ten years, and has proved the most destructive of epidemics. There is also reason to believe, that a modified condition of the atmosphere may remain for years after the prevalence of the disease, and occasion a liability to affections of a similar character, to which the term *influenzoid* might be applied. For eight years after the prevalence of influenza at Lyons, this was found to be the case, 1300 deaths out of 10,096 occurring during that period, being attributed to catarrhal or mucous fevers. We are inclined to believe, that a similar condition has existed in this country since the epidemic of 1833, affections of the bronchi and fauces having been unusually prevalent, associated with severe muscular pains and unusual depression of strength. If this be the case, the subject is one of great importance, and well deserves special investigation.

Diagnosis. Bronchitis is perhaps the only disease with which influenza can easily be confounded. The former affection, however, is generally induced by atmospheric changes, and attacks the predisposed; the latter has comparatively little reference to changes of weather, affects all individuals nearly equally, and is attended with more local pain and general debility than is proportionate to the severity of the catarrhal symptoms.

Nature of the disease. Uncomplicated influenza rarely destroys life, and the

appearances detected in the bodies of those who have died while suffering from the malady, have been usually the relics of some associated disease. In the few cases of death which have occurred from simple influenza, the following are the chief appearances which have been observed:—The mucous membrane of the larynx and bronchi has been found of a deep red colour, flakes of lymph have been sometimes observed on the chordæ vocales and in the ventricles, and the trachea has been injected and covered with glassy-looking mucus; the lungs surcharged with serous and mucous fluid, and having portions of their lower lobes engorged and sometimes consolidated.

The danger, in extreme cases of influenza, appears to arise from an excess of mucus preventing the due arterialization of the blood. The difficulty and rapidity of respiration are, however, out of all proportion to the quantity of secretion, or even to the amount of inflammation, and the dyspnoea is sometimes intermittent; and this circumstance cannot easily be explained except by supposing that the cause of the disease must operate, by producing an impression on the vital energy of the lungs, analogous to that occasioned by cutting the nervus vagus; and we may reasonably conjecture that influenza depends on an influence exerted on the nervous system, especially on that part of it having most relation to the bronchial mucous membrane, tending to elicit any latent predisposition to disease, and modified in its character by varieties of constitution as well as by peculiarities of climate and other external conditions.

This opinion derives support from the liability, so frequent in this complaint, to derangement in a great variety of organs, as well as from the occasional occurrence of inflammation of the spinal chord, and of inflammation or other affections of the brain. The effects of such a shock thus communicated to the nervous system may be expected to develop themselves in the weakest organ, and to vary according to collateral circumstances. Thus, in the same epidemic, one patient will suffer from meningitis, another from enteritis, a third from rheumatic affections. If a sudden increase of temperature succeed to frost or snow, pneumonia will frequently be found associated with the complaint, whilst exposure to fatigue and mental anxiety will increase the liability to erysipelatous complications.

Sources of the epidemic. In entering on this inquiry, it is necessary to recall some of the most prominent circumstances which have attended the progress of the disorder: and although most of the accounts which have been given abound in discrepancies, partly arising from real diversity in the phenomena, partly from the preconceived opinions of those who have written on the subject, we shall still be able to select several particulars in which nearly all observers concur.

The course of influenza is singularly analogous to that of epidemic cholera. It almost invariably travels in a westerly direction, and from the south towards the north. In proceeding from the east, it passes through Russia and the north of Germany to England, and then turns round through France and Spain to Italy. When arising in the south, its course is from Italy through Spain, France, Britain, and the Netherlands. The average period during which the disease rages in any place is generally six weeks. When specific inquiries have been made to ascertain the truth in this respect, as in Cheshire in the epidemic of 1782, and throughout England in that of 1836, the results have confirmed this statement, which rests on the concurrent testimony of a very large majority of authors: a partial outbreak of the epidemic has, however, frequently occurred a week or more previously to its general prevalence in an affected place. This circumstance was frequently remarked in the visitation of 1836, particularly at Stratford-on-Avon, Chester, and Southampton.

There are circumstances recorded making it appear probable that the atmosphere of a district in which catarrhal fever has recently prevailed is sometimes so modified as to be capable of producing the disease in visitors some weeks after it has ceased to rage among the inhabitants. For example, in 1782, a family ar-

living in London from the West Indies, two months after the cessation of influenza, became affected with the disease; and at Liverpool in 1837, the crews of ships arriving from America were often attacked two months after the inhabitants of the place had become proof against the epidemic influence.

Some visitations have most severely affected persons of the sanguine, and others those of the phlegmatic temperament; in some instances those most exposed to the weather have suffered most, in others the reverse has been the case; and it is agreed that no constitution or condition is at present known capable of securing immunity from this all-pervading malady. One of the correspondents of the London Medical Society (*Mem. Lond. Med. Soc.*, vol. vi.) mentions that no case of the disorder occurred in a work-house near Reigate, where 200 were employed in the manufacture of blankets; and he seems inclined to attribute their escape to the free use of oil in the preparation of the blankets; but we need not have recourse to such an explanation, since many other instances occurred during the epidemic, in which persons living in sheltered habitations remained free from the malady. Probably the most remarkable and inexplicable case of exemption which has been recorded, is that mentioned by Mr. Greenhow, of 300 women engaged in coal dredging in the sea at Newcastle.

We now proceed to inquire how far the different theories regarding the origin and extension of the epidemic can be reconciled with acknowledged facts; and we shall particularly notice among the alleged causes of its origin or extension, contagion, atmospherical vicissitudes, the diffusion of foreign substances in the atmosphere, and electrical conditions.

Cullen designated the disease *Catarrhus contagiosus*, and many other authors have attributed its prevalence to this cause: but epidemics into which contagion enters as an important element, for the most part advance slowly, attack masses in succession, and affect different classes of the community at different times. The diffusion of influenza over a whole country is occasionally so rapid as to be absolutely inexplicable on the doctrine of contagion, which is also inadequate to explain its frequent extension among the lower animals, having no communication with one another. The theory of contagion is also incapable of explaining the occurrence of the disease in ships at sea, of which several remarkable instances occurred in the epidemic of 1782: for example, in the *Atlas*, East Indiaman, between Malacca and Canton; in the ship of Admiral Kempenfelt, whilst cruising between Brest and the Lizard, and in the fleet of Lord Howe off the coast of Holland, these vessels in every instance having put to sea some weeks before influenza appeared at the ports from which they sailed. On the other hand it must be acknowledged, that the disease occasionally attacks the members of a family in succession, after the manner of a contagious malady. It is also true that, in many instances, when an individual affected with the disease comes from a distance to any place, the inhabitants of the house he visits are often the first attacked. This was particularly observed at Norwich and St. Alban's in 1782. (Dr. Hamilton, in *Mem. of Med. Soc.*) Dr. Haygarth obtained specific information regarding the same epidemic as it occurred in ten of the towns of Cheshire; and in seven instances of the ten the first cases presented themselves in houses at which travellers had arrived from affected places. A similar observation was made in the last visitation. (*Trans. of Med. Prov. Assoc.*) Such evidence is too forcible to be altogether disregarded, and we therefore incline to the opinion, that this disease may be occasionally propagated by personal intercourse. At the same time we should consider this mode of communication incidental and occasional, not essential, and should place influenza very low in the scale of contagiousness.

Another cause which has been assigned for the production of this remarkable disorder is great atmospheric vicissitudes of temperature or humidity, and the prevalence of particular winds. We have been careful to relate the most important phenomena having reference to this inquiry; and at first sight there appears to be some evidence in favour of the theory of sudden changes of temperature, northerly winds, thick fogs, and other indications of an unsettled state of atmosphere

having been present in numerous instances. The comparative mildness of the complaint in sheltered dwellings has been frequently noticed, especially in the epidemic of 1803: and a remarkable circumstance is mentioned by Dr. Carrick, rather favourable to the explanation under review. On Clifton Hill is a range of building called Richmond Terrace, forming three sides of a parallelogram, respectively fronting east, south, and west. During the prevalence of influenza in 1803 scarcely an individual residing in the side fronting the east escaped the disorder, whilst a majority, both of persons and families living on the south side, remained entirely free from the malady. We may add that the disease has prevailed most frequently in severe weather. Of 56 epidemic seizures in Europe, 22 have been in winter, 12 in spring, 11 in autumn, and 5 in summer. There is, however, too much evidence of an opposite character to allow us to be satisfied with this explanation. The disorder has prevailed in every climate, at almost every season, and during every variety of wind and weather. In 1580 it raged during a sultry autumn; in 1830 at Manilla in the month of September, during a temperature of from 78 to 92 degrees; and in 1836 it existed at the same time in Cape Town and London, the season being mid-summer in the one place and mid-winter in the other. Vicissitudes of temperature, damp weather, and melting snow have often existed to a great extent without inducing influenza, although they have a decided tendency to produce catarrhal, bronchial, and pneumonic affections, and when present during the prevalence of influenza to superinduce such complaints as complications.

The theory which refers the cause of the malady to the diffusion of some noxious matter through the air demands consideration. It may not be irrelevant to observe, that spots upon linen and other articles, resembling those occurring from leprosy, have been noticed during the prevalence of cholera and plague, and that such appearances give a plausible aspect to the idea that some tangible material is engaged in the production of such epidemics. It cannot be denied, that minute substances diffused through the atmosphere occasionally produces effects in some respects analogous to influenza. Cases are related (*Rust's Mag.* and *Lond. Med. Gaz.*) in which urgent dyspnœa, spasmodic cough, dryness of fauces, quickness of pulse, and great debility, were produced by inhaling the powder of ippecacuanha; in one of these cases the symptoms were aggravated by bleeding. The production of hay-asthma by the odoriferous particles of the vernal grass, may be adduced as additional evidence of the possibility of such an occurrence. If, however, the epidemic could be referred to such a cause, the uniformity in the period of its continuance in any place it visits would lead to the impression, that the cause must be liable to gradual development and decline, and therefore be organized. The observations of Ehrenberg have proved the abundant prevalence of animalcules in our atmosphere, and it is not improbable that vegetable germs may also abound in it. The supposition is allowable, that such organized matter, if existing, may suffer modification, more or less extensive in quantity or condition under the influence of magnetical or other changes, which may alter the relation of the atmosphere to living beings, and by engendering or diffusing some peculiar virus become a source of disease. Such an idea is however purely speculative. Facts approaching nearer to the character of evidence may be adduced in favour of the opinion, that mineral impregnations adequate to produce analogous disorder may exist in the atmosphere. It is difficult to suppose, that the same mineral deterioration could arise in every variety of soil; but the difficulty may be slightly diminished by assuming a volcanic origin. Berzelius, after inhaling a small quantity of seleniuretted hydrogen lost the sense of smell, and suffered from catarrh, suffused eyes, and cough, for many days. Dr. Prout has ingeniously remarked, that some combination of selenium may be diffused through the atmosphere and produce epidemics. (*Bridgewater Treatise*, p. 357.) This substance is often associated with sulphur in volcanic emanations, and there appears to have been a connexion between the acrid dry fogs, which often preceded or accompanied influenza, and volcanic eruptions, especially in the year 1782. Even the grosser kinds of volcanic matter

may be thrown to a considerable extent. In January, 1835, for example, dust was carried in the opposite direction to the wind, and therefore evidently in a counter-current, from Coseguina in Nicaragua to Chiapa, a distance of 1200 miles; and it is easy to suppose, that gaseous emanations may spread still more widely through the air. At the same time it must be allowed, that the systematic duration of the complaint for a certain number of weeks, and the similarity of its violence in all parts of the world, is unfavourable to this hypothesis.

The electrical theory remains to be noticed. M. Weber was so firmly convinced of the dependence of the complaint on a negatively electrical state of the atmosphere, as to recommend for a preventive, socks made of non-conducting materials, such as oiled silk, or paper covered with sealing-wax. Dense isolated clouds in a state of negative electricity have been occasionally observed at the commencement of epidemics. Influenza has often been preceded by violent storms, and in the years 1775 and 1803 meat exposed to the atmosphere was rapidly tainted; circumstances rather favourable to the assumption of a connexion of the epidemic influence with electrical conditions. It is true that this theory is not at first sight consistent with the systematic duration of the complaint, and that the observations of Volta did not detect any electrical changes in the atmosphere of affected places. Still the science of electricity is not sufficiently advanced to enable us to decide against this view; and the singular exemption of the coal-dredgers at Newcastle, exposed continually to a conducting medium from standing in the sea, is favourable to the modification of the electrical hypothesis entertained by Dr. Schweich, who appears to attribute the disease to a condition of atmosphere favourable to the production of accumulated electricity in the animal body. (*Die Influenza, &c.*)

The uniformity of the course of influenza from east to west, thence turning round to the south, may be conceived to intimate some connexion with magnetic currents; and it is not improbable that magnetical conditions may have some effect in predisposing the system to the morbid influence, or in modifying the causes on which the malady may essentially depend.

Treatment. Notwithstanding the general analogy presented by different visitations of influenza, there is yet so great a variety in the prominent symptoms of any visitation, that our experience of one is an insufficient guide to the treatment of another. Indeed in any single epidemic the derangements of health produced in different subjects are so diversified, and our knowledge of the organic changes on which they depend is so incomplete, that we cannot reduce the plan of treatment to a systematic form. An attempt to divide the disease into different stages and to fix the appropriate treatment for each, would lead to unnecessary refinement, rather than conduce to practical utility; and it will probably be sufficient to speak of the management adapted to the complaint at its commencement, in its progress, and in its decline. In the slighter manifestations of the disorder we must confine our treatment to the mildest measures. A careful regulation of the diet may be alone sufficient. When the employment of remedies is expedient, we believe that too much importance cannot well be attached to the use of mercury followed by an aperient at the onset of the malady. In a considerable proportion of cases, a dose of calomel combined with compound extract of colocynth, followed by a saline purgative, will be found of signal utility, obviating congestion, diminishing the liability to local inflammation, and rendering the subsequent affection milder and more transient. In many instances a single dose of the remedy seems to accomplish the object; in others it may be once or twice repeated on alternate days with advantage. Even when some degree of intestinal irritation is present, mercury in a milder form may usually be administered. Under such circumstances, mercurial pill combined with an anodyne extract, as that of hemlock or henbane, may be employed, and for subsequent use castor oil will be the most suitable aperient.

In a few cases without the previous adoption of this plan, and in nearly all after its employment, more especially if the skin is hot and the pulse frequent, it will

be desirable to confine the patient to bed, and administer mild diaphoretics. Perhaps the most appropriate remedy of this class is acetate of ammonia, which may be combined with ipecacuanha if a mild expectorant is required; and if there be much attendant irritation of the bronchial tubes, with antimonial wine. In cases accompanied with any degree of crepitating rhonchus, a few leeches may usually be applied with advantage. The complication of pneumonia is that which most frequently renders bleeding expedient, but as in the pneumonia of typhus, this measure must be employed with caution. The state of the pulse materially assists in determining the question. Ozanam mentions, that of fifty-two epidemic catarrhs which have prevailed in Europe, bleeding was found useful in thirty-nine, hurtful in ten, and useless in three. In every visitation of influenza there are instances in which this measure may be requisite; but as the disease appeared in Britain, with the exception of the epidemics of 1775 and 1803, the cases requiring its employment have been comparatively rare; and it may probably be admitted as a general rule, that inflammation associated with influenza should be treated less actively than when uncombined. This rule applies even to the complication of pleuritis and of pericarditis. When pain of the frontal sinuses, or cerebral symptoms, are distressing, a few leeches applied to the Schneiderian membrane often give material relief. When convulsive cough is present, hydrocyanic acid is a suitable remedy. Ipecacuanha combined with oxymel of squills may be administered if the cough is unattended with expectoration. If, as commonly occurs in those who are subject to asthma, there is congestion of the bronchial mucous membrane characterized by sonorous and sibilous rhonchi, ætherial tincture of lobelia inflata may be administered according to the recommendation of Dr. Llakiston. Having found this remedy useful in chronic bronchitis, he was induced to try it in influenza, the dose being from ten minims to half a drachm diluted with two ounces of water. He considers it a narcotic, acting on the organs of circulation through the nervous system, and controlling the quantity of blood sent to the lungs. Alkalies may be combined with the lobelia if the bronchial secretion be tenacious and difficult of expectoration. In cases partaking of the character of suffocative catarrh, mustard poultices should be applied, and senega with ammonia and paregoric, or, in some instances, the Lobelia inflata. Ammonia is peculiarly adapted to cases of profuse bronchial secretion, associated with depression of nervous energy.

In some extreme cases, acetate of lead has proved singularly efficacious in checking inordinate secretion from the bronchial tubes. When there is remarkable slowness of the pulse, either spontaneous or produced by treatment, brandy, may be given with advantage, and the cordial plan may be continued so long as it improves the pulse without increasing the cough. In the decline of the affection, in cases which have materially involved the bronchi, copaiba will be found useful in improving the secretion and correcting the morbid condition of the mucous membrane; and where a more stimulating expectorant is requisite, as in the old, and in cases which have assumed any degree of the suffocative character, ammoniacum and squill may be preferred. In the later periods of such affections, opium is a useful auxiliary; but, notwithstanding the sanction of some eminent practitioners, we believe its premature use to be hazardous, calculated to check secretion, and often to induce inflammation. If restlessness at night be distressing, and tincture of henbane prove inefficacious, morphia may be given with advantage. Should bilious diarrhœa occur, mucilaginous drinks, sometimes combined with laudanum, are indicated, and emetics if there is nausea or vomiting. In these cases the state of the tongue affords us much assistance in determining on the plan of treatment. If it be covered with a thick fur, especially if the bowels are confined, purgatives are requisite, but if it be preternaturally red and the epigastrium be tender, demulcents, counter-irritants, and even leeches to the epigastrium should be employed.

When a febrile condition continues, associated with much debility, and espe-

cially, if presenting phenomena of an intermittent character, quinine, and Battley's solution of the yellow bark are eligible remedies.

Sequelæ. We have no conclusive evidence that phthisis can be absolutely produced by influenza, but it is indisputable that previously existing tubercular disease may be called into activity by it. Chronic bronchitis and asthmatic affections, are frequent consequences of the malady, and are often found very obstinate. It is remarkable that the severity of the sequelæ bears no proportion to the violence of the attack of influenza. Thus after the mild visitation of the year 1762, a peculiarly severe and fatal dysentery prevailed.

It should not be forgotten that influenza, perhaps through the medium of a shock communicated to the nervous system, often leaves a state requiring considerable and prolonged attention. Even when no particular disease is superinduced by the attack, the mind and body do not for a considerable time recover their ordinary energy: fatigue is easily produced; there is increased liability to bronchial affections, perhaps a morbid condition of the membrane of the nostrils; greater susceptibility of the mucous membrane of the intestines to irritating medicines, or to injudicious diet, and of the skin to atmospheric vicissitudes; and if the patient have been previously subject to neuralgic or rheumatic affections, or to cutaneous eruptions, they will be easily reproduced. In such instances, simplicity of diet, cool rooms, change of air, diminished amount of intellectual labour, the shower bath, and the general adoption of a mildly tonic plan, will be requisite.

A S P H Y X I A.

Preliminary observations.—Causes.—Phenomena.—Anatomical characters.—Nature.—Treatment.—Strangulation.—Anatomical characters.—Treatment.—Submersion.—Anatomical characters.—Treatment.

THE literal meaning of this term (according to its derivation from α priv. and $\sigma\phi\upsilon\chi\eta$, pulse) is a loss or suppression of the pulse, indicative of a failure in the action of the heart, constituting what is now known as *Syncope*. It is, however, universally employed at present to designate the cessation of the function of respiration (or rather, of its essential part, the aëration of the blood,) and the consequent suspension of the heart's action.

Preliminary observations. In order to have a clear idea of the pathological condition thus indicated,—of its causes, nature, and results,—it is necessary to take a brief survey of the character of the respiratory process, and of its connexion with the other vital functions, especially those of circulation and nutrition. This process essentially consists in the interchange of ingredients between the blood and the atmosphere, when brought within the sphere of each other's action in the organs adapted to the purpose. There is, on the one hand, an extrication of carbonic acid from the circulating fluid; and, on the other, an absorption of oxygen from the atmosphere. Although these are not the only changes which take place in the process of aëration, they are the most important to the present inquiry, from their immediate necessity to the continued well-being of the animal. The nutritive fluid, by its circulation through the capillaries of the system, undergoes great alterations both in its physical constitution and vital properties. It gives up to the tissues with which it is brought in contact some of its most important elements; and, at the same time, it is made the vehicle of the removal

from these tissues of ingredients which are no longer in the state of combination that fits them for their offices in the animal economy. To separate these ingredients from the general current of the circulation, and to carry them out of the system, is the object of the excretory organs; and it is very evident that the importance of their respective functions will vary with the amount of the ingredient which they have to separate, and the deleterious influence which its retention will exert on the welfare of the system at large.

Of all these injurious ingredients, carbonic acid is without doubt the most abundantly introduced into the nutritive fluid; it is also most deleterious in its effects on the system, if allowed to accumulate; and we accordingly find the provisions for its removal surpassing in importance that made for any other excretion. The two largest glands in the body appear to have for their chief object the separation of carbon from the blood; but this operation is subservient in each case to other purposes. By the liver this element is combined with others into a fluid excretion, which has important uses in the digestive function; whilst by the lungs (which may be certainly regarded as organs of a glandular character) it is excreted in a gaseous form, and thus made subservient, according to the laws of the mutual diffusion of gases, to the introduction of oxygen into the system, and the consequent maintenance of the animal temperature as well as of the stimulating properties of the blood.

It is evident, then, that any circumstances which check the excretion of carbonic acid by the lungs, will have an immediately injurious effect upon the system at large, by causing the accumulation in the fluid upon which it is dependent for the performance of its vital actions, of an agent that so seriously injures its vivifying properties. But this is not the only mode in which the cessation of this function is injurious. The exclusion of a constant supply of oxygen from the blood, even though the removal of the carbonic acid were provided for by other means, deprives it of its due power of nourishing and exciting to action the tissues and organs to which it is afterwards distributed; for it would appear that this element is, throughout animated nature, a stimulant as necessary to the energy of its operations, as caloric is to all, and light to many of these. Farther, we shall hereafter see reason to believe that any obstruction to the due aëration of the blood has an immediately injurious effect upon the circulation, by causing a retardation or even an entire cessation of its movement through the capillaries of the lungs; and, in consequence, a dangerous accumulation of blood in the venous system, with a proportional deficiency in the arterial.

We observe, accordingly, that a provision for these changes is more universally found to exist in living beings than for any other function, save the ingestion of aliment, and the perpetuation of the race. Even in plants a true respiration analogous to that of animals is constantly going on, although its effects are sometimes obscured by the converse change which is subservient to a different purpose. (*Principles of general and comparative Physiology*, p. 294.) In the lower animals the process is carried on by means which render it equally independent of any active movements adapted expressly to the purpose. In proportion to the energy and variety of the nutritive processes, however, does the necessity arrive for a more powerful and constant respiration; and we find in the warm-blooded *Vertebrata* the highest activity of this function provided for by the vast extension of the aërating surface, and by the means adapted to renew both the blood and the air in contact with it. The arrangement of the circulating apparatus is such, that *all* the blood which has been returned from the system is made to pass through the lungs, before being again transmitted through the aorta—a provision which is not made for any other gland, the portal circulation presenting the nearest approach to it. And, on the other side, the nervous and muscular systems are adapted to keep up, without the intervention of the will of the individual, a constant series of movements, by which the air that has been vitiated is replaced by a pure supply. Although these arrangements will be fully explained in the physiological division of this work, it is necessary here to advert

to the mode in which these constant changes are maintained, in order that the operation of various causes in the production of asphyxia may be rightly understood.

The periodic movements of the heart, by which the blood is propelled into the capillaries both of the system and of the lungs, result, there is good reason to believe, from the simple contractility of its muscular structure, excited by the direct application of a stimulus. Experiment seems to have sufficiently demonstrated that, although they may be influenced by particular conditions of the nervous system, they are not dependent upon any constant influence transmitted through it, as was formerly supposed. Like other muscular structure, the parietes of the heart may be excited to contraction by stimuli of various kinds; but that which is employed in the living body is the contact of blood with the membrane lining its cavities. So long as the fibre retains its vital properties, will this stimulus excite it to contraction; but if it be deficient, and not replaced by any other, no movement will take place. In those cases in which the movements of the heart have continued for many hours after it has been removed from the body, it is probable that the admission of air to the interior of its cavities has acted as the stimulus. Over-distention of the muscular tissue appears to suspend for a time its contractility; and this effect may even be produced by the accumulation of blood in excessive quantity, which prevents the fluid from exercising its usual stimulant influence.

On the other hand, the movements of the respiratory muscles are entirely dependent upon the influence of the nervous system. Their ordinary actions are of the class denominated by Dr. M. Hall *excito-motor*, and were spoken of by Whytt and other authors as *sympathetic*. They result from a stimulus originating in the extremities of the nerves usually denominated *sensory*, but which may be more properly called *afferent*; and this, being conveyed to the spinal cord, occasions the propagation along the motor or *efferent* nerves of an influence which excites the muscles to action. The afferent or excitor nerves most concerned in producing the respiratory movements are the pneumonic portion of the par vagum, and those which supply the surface of the face and body. The impression of the external air on the skin (itself in some degree a respiratory organ) seems to be the stimulus which acts through the latter; and it is in this manner that the first inspiration of the infant is excited. The presence of venous blood in the lungs has usually been considered as the stimulus which acts through the par vagum; but Dr. M. Hall contends, with some apparent justice, that it is the evolution of carbonic acid which is to be regarded in this light. However this may be, it is admitted on all hands that, after the function is once actively established, the impression of the *besoin de respirer* conveyed by the pneumogastric is the principal source of the continuance of the movements. From the recent experiments of Dr. J. Reid (*Edin. Med. and Surg. Journ.*, April, 1839,) it appears that, although they will continue after section of these nerves, they are much diminished in frequency. The great interchange of filaments which has been proved to take place between the pneumogastric and the sympathetic, joined to certain "residual phenomena" brought to light by experiment, leaves little doubt that the latter system of nerves also is concerned in the maintenance of the respiratory movements, its function being perhaps supplementary to that of the pneumogastric. We may suppose, also, without much improbability, that the *besoin de respirer* may be produced by impressions transmitted from other parts of the system as well as the lungs, when imperfectly arterialized blood is transmitted through its capillaries; just as the sense of hunger seems to depend, not only upon the emptiness of the stomach, but upon the demand for nutrition existing in the body at large. It will be observed that the two most powerful excitors of these actions, the pneumogastric and the fifth pair, terminate in the medulla oblongata; and that the motor nerves by which the most important of them are called into play arise in their neighbourhood. Hence respiration may continue when the portions of the nervous centres, both above and below this division,

have been removed, which has caused it to be regarded as the peculiar seat of life.* A little consideration will show, however, that it is so only by furnishing the mechanical conditions requisite for the real organic function of respiration, to which the inspiratory and expiratory movements are but superadded actions properly forming part of the animal functions. We are now prepared to consider the causes which may operate in the production of asphyxia.

Causes. The variety of conditions required for the healthy performance of the function we have been considering, involves a similar diversity in the causes which may produce its suspension. These may, however, be classed under two general divisions: the *first* comprehending those which mechanically prevent the contact of the aëriform medium surrounding the animal with the membrane lining the lungs; and the *second* including those which affect the chemical processes to which this contact is subservient.

I. This division embraces a great variety of causes, which must be separately considered.

1. Those which suspend the respiratory movements, by interrupting the nervous circle through whose agency they are maintained. Thus, section of the eighth pair of nerves on each side may induce asphyxia, though slowly, by suspending the transmission to the medulla oblongata of the stimulus originating in the lungs. If no other excitor nerves existed, there can be little doubt that this operation would suspend the usual respiratory movements as completely as section of the motor nerves themselves, though they might still be performed by an effort of the will; but the other excitors, which have been already specified, have sufficient power to maintain these actions, although with far less than the normal energy and regularity. The asphyxia of new-born infants arises from the want of a sufficient impression upon these superadded excitors, by which the first inspiration is occasioned; as is shown by the effect of the stimulus of cold air on the face, or of the smart stroke of the palm on the body, in producing this essential movement. The nervous chain may be also interrupted at the point of communication between the afferent and efferent nerves, namely the spinal cord. Any want of integrity in the portion of this central organ which is included between its connexions with these nerves, will obviously impede the transmission of the necessary influence, as completely as lesion of the nerves themselves. This is by no means unfrequently exemplified in the effects of the disease or accidents to which this part is subject. Thus, fracture or dislocation of the upper part of the cervical vertebræ may produce compression or laceration of the cord above the origin of the phrenic nerve. In this case all the respiratory movements of the trunk are immediately suspended, except those produced by the spinal accessory nerve, which are by no means alone sufficient to maintain the constant exchange of air which is required; and death, therefore, very rapidly supervenes. If the affected part of the cord be below the origin of the phrenic nerve, but above that of the intercostals, life may be prolonged for some time; but a slow asphyxia appears to take place, since death generally occurs at an interval of from three to seven days. (Sir A. Cooper, *on Dislocations, &c.*) The same effect will result from want of functional activity in this portion of the nervous centres, although no disease or injury may have directly affected it. Thus, in the ordinary apoplectic coma, as in profound sleep, the functions of the medulla oblongata being but little impaired, the respiratory movements continue almost as usual; but if, by compression or other deleterious influence, it should become less able to respond to the stimulus communicated to it by the excitor nerves, the movements will cease more or less gradually, and the aëration of the blood will be consequently prevented. A similar condition may result from the operation of narcotic poisons, by which the functional activity of the

* In the class *Tunicata* there is but a single ganglion, and this seems almost entirely devoted to the maintenance of the respiratory movements; so that Nature may be regarded as here presenting the physiologist with an anticipation of the above experiment. (See the author's *Prize Thesis on the Nervous System of the Invertebrata*, p. 51.)—AUTHOR.

whole nervous system, but more especially of its central organs, is depressed, and the respiratory movements in consequence suspended for want of the maintaining power. Section of the motor nerves will of course produce a corresponding effect. If the phrenic be divided, respiration may be carried on for a short time by the intercostals, but not in a degree sufficient for the prolongation of life. If the intercostals be divided, the animal will respire with difficulty and imperfectly, as when the spinal cord is injured above their origin; and slow asphyxia is usually the result. There is a difference among different species, however, as to the degree in which the movements of the diaphragm and those of the thorax are respectively concerned in producing the ingress of air. In birds it is entirely dependent upon the elevation of the ribs, no complete diaphragm existing in that class; and paralysis of the intercostal muscles, by the division of the spinal cord above their nerves, consequently produces immediate asphyxia. In fishes, on the other hand, the respiratory movements can only be affected by injuries of the medulla oblongata, as all the nerves concerned in them arise from that division of the spinal axis.

2. The next group of causes to be enumerated is composed of those which prevent the dilatation of the thoracic cavity by mechanical compression of the exterior of the body. Instances are by no means rare in which persons engaged in excavating are suddenly overwhelmed by a fall of earth which closely envelopes the body, leaving the head free. If not speedily relieved from such a situation, the sufferer dies of asphyxia; since the descent of the diaphragm is prevented by the compression of the abdomen, as well as the ascent of the ribs by the restraint to which the thorax is subjected; and the first shock expels the contents of the lungs, and reduces the cavity to its smallest dimensions. A curious case is mentioned by Dr. Roget (*Cyc. of Prac. Med.*, vol. i. p. 177.) in which a similar result was very near occurring to a pugilist, of whose body a cast was being taken in one piece. As soon as the plaster began to set, he felt deprived of the power of respiration; and, to add to his misfortune, was cut off from the means of expressing his distress. His situation, however, was perceived just in time to save his life. The due expansion of the thoracic cavity may also be prevented by accumulation of fluid or the growth of tumours in the abdomen, by which the descent of the diaphragm is impeded; but though a very distressing amount of dyspnœa often results from this cause, it is not likely ever to produce absolute asphyxia. Any disease which occasions a very painful condition of the contents of the abdomen, such as acute peritonitis, will offer a similar impediment to the movements of the diaphragm; as will inflammation of the pleura or pericardium, or rheumatism of the external muscles, to those of the thorax.

3. Asphyxia may take place from disorder of the mechanism of respiration, without the existence of any force externally compressing the thorax, or of any direct impediments to the entrance of air into the lungs. These organs may be prevented from dilating by an accumulation of fluid in the pleural sacs; or by the admission of air into the thoracic cavity, either through its parietes, or through the lungs. If an aperture be made into the cavity on one side, so that air rushes in at each inspiratory movement, the expansion of the lung on that side will be diminished or entirely prevented in proportion to the size of the aperture. If air can enter more readily than through the trachea, an entire collapse of the lungs will take place; and if such apertures be made on both sides, asphyxia necessarily results. But if they are too small to admit the very ready passage of air, the vacuum produced by the inspiratory movement will be more easily filled by the distention of the lungs; so that a sufficient amount of change takes place for the maintenance of life. Sudden death by asphyxia not unfrequently occurs from a communication being opened by disease between the air-passages and the pleural cavity, so as to check the dilatation of the lung of that side, whilst the function of the other is impeded by tubercular deposition, hepatisation, or some other morbid alteration of its structure.

4. The next group of causes is a very numerous one; and those which it in-

cludes, although operating upon the respiratory process in the same manner, are very different amongst themselves. It is composed of those which interfere with the admission of air into the air-cells (where alone it is brought into relation with the blood,) either by altogether preventing its entrance into the passages, or by obstructing its movement through them. The entrance of air into the trachea will of course be prevented by any means which produce occlusion of the orifices that lead to it—the mouth and nostrils. If these be obstructed by any solid substance applied closely upon them, death is said to take place by *suffocation*. If the face be immersed in water, that air can gain no admittance to these openings, asphyxia is said to be produced by *submersion*. It is obviously immaterial whether the whole body be covered with water or not; many drunkards have been drowned (so to speak) in a puddle, from which they had not sense enough to withdraw their faces; and many infants have been prevented from making the first inspiration by the immersion of the mouth and nostrils in the pool formed by the maternal discharges, or by the occlusion of these entrances by their own membranes. Air may gain admittance to the mouth and nasal passages, and yet be prevented from passing into the trachea, by meeting with some obstruction in the larynx. The rima glottidis may be closed by the œdema resulting from acute inflammation, or by the thickening which is produced by more chronic disease; or it may be constricted by the spasmodic affection which so often accompanies these states, and which sometimes occurs independently of them, from irritation of the nervous system by other causes; or it may be closed in consequence of paralysis of the dilating muscles, as Dr. H. Ley believed to occur in laryngismus stridulus.* Obstacles to the admission of air into the lungs may also exist in the trachea; the aperture of which may be closed by external pressure, as in *strangulations*, or its lining membrane may be so much tumefied by disease as nearly to prevent the passage of air. The accumulation of secretions, too, which the patient has not strength to expectorate, may occasion asphyxia; and the same result sometimes occurs in croup, from the obstruction presented by the formation of a false membrane, which is often of considerable thickness. The pressure of tumours upon the trachea will often produce asphyxia, which has been the immediate cause of death in many cases of aneurism, and in some of bronchocele. In such cases this condition gradually supervenes; and the difficulty of respiration is indicated by the

* The pathological explanation of this disease given by Dr. Ley was founded upon the supposition, that the *dilators* of the rima glottidis are supplied by the recurrent laryngeal nerve, whilst the constrictors of that opening are stimulated by the superior laryngeal branch. He thence inferred that, if the functions of the former nerve were impeded by the pressure of enlarged glands or other causes, and the muscles which it supplies be consequently paralyzed, the constrictor muscles would close the rima glottidis for want of opposition. The more recent experiments of Dr. J. Reid (*Edin. Med. and Surg. Journ.*, vol. xlix.) however, have shown that the superior laryngeal is almost entirely a sensory nerve, and that the recurrent is almost exclusively motor, supplying both constrictor and dilator muscles. He states that “severe dyspnœa amounting to suffocation may arise both from *irritation* and *compression* of the inferior laryngeal nerves, or the trunks of the pneumogastrics. For when both or even one recurrent nerve was irritated, the arytenoid cartilages were approximated, so as in some cases to shut completely the superior aperture of the glottis.” (p. 149.) When the recurrences are cut or compressed, the arytenoid cartilages are no longer separated during inspiration; and their movements become so completely passive, that they are carried inwards by the current of entering air, which they consequently impede, whilst they are separated again by the expiratory blast. “We shall leave it,” continues Dr. R., “to those who have had frequent opportunities of seeing this disease to determine which of these two causes, irritation or paralysis, will best explain its phenomena. There appears, however, to be little doubt that the crowing respiration and dyspnœa, which accompany some cases of hysteria, depend upon a spasmodic closure of the glottis, produced by some irritation of the recurrent nerves.—*Author.*”

livor of the countenance and the dilatation of the nostrils, for a long time previous to the termination of life. Sometimes, however, an aneurism or abscess will burst into the trachea, and occasion immediate death by suddenly obstructing the access of air to the lungs. A frequent cause of asphyxia is the presence of foreign bodies within the air-passages, or even in the pharynx. In the former case they may occasion speedy death, even though not of sufficient size to produce material obstruction to the passage of air by the irritation they excite; during a fit of coughing they may be driven up against the rima glottidis, which they may mechanically obstruct; or they may occasion spasmodic closure of this orifice by reflex excitement of the laryngeal nerves. The increased secretion also, which results from the irritation, adds to the mechanical impediment; so that, from a combination of these causes, death by asphyxia often supervenes where at first no material obstruction to respiration appeared to exist. The lodgment of large masses of solid matter in the œsophagus, as when an attempt is made to swallow hard substances which are too bulky for its caliber, will sometimes produce immediate asphyxia, as if by strangulation; or, if a partial obstruction only be created, the difficulty may be fatally aggravated by the spasmodic action which is excited, as in the last case. These are the most frequent cases of obstruction to the entrance of air through the larynx and trachea. The bronchial tubes also may be similarly affected; but the amount of impediment thus created in the respiratory process will depend upon the proportion of the pulmonary structure which the particular tube supplies. A foreign body obstructing one of the passages into which the trachea primarily divides, will of course impede, more or less completely, the respiratory action of the corresponding lung, and may thus induce slow asphyxia, which will be aggravated by the spasmodic actions to which the irritation of its presence gives rise. But if it should find its way to one of the smaller passages, no immediately fatal result would probably occur; though diseased action would probably be excited in its neighbourhood, which might ultimately terminate life. Several instances are on record in which such an occurrence has seemed to be the remote cause of death. A fatal result may, however, be speedily occasioned by causes which affect the bronchial tubes only, if it involve them universally or nearly so. Thus it may take place from the accumulation of secretions or fluid effusions, which prevent the entrance of air to the air-cells, even though it freely pass through the trachea. This is very apt to occur as a consequence of a congested state of the pulmonary vessels brought on by other causes; and it aggravates this very condition by the new obstacle it opposes to the respiratory process, and to the movement of blood through the capillaries. Such a state may be artificially induced by section of the pneumogastric nerves; but it also supervenes, to a greater or less extent, on many pulmonary diseases. Perhaps we may include, under this class of causes, spasmodic constriction of the bronchial tubes, which seems to be an impediment to respiration in some forms of asthma: the existence of such a state is, however, uncertain; and no experimental proof has yet been given of the power of nervous irritation to produce it. It is, however, the only feasible mode of accounting for some of the phenomena of this disease.

5. Supposing the air necessary for respiration to have obtained free admission through the trachea and bronchial tubes, asphyxia may still take place from the lungs themselves being in an unfit state to allow the due action between their gaseous contents and the blood. Various morbid alterations of their structure, which it is needless to specify, may thus prove fatal, and this, either rapidly or slowly, according to the progress of the disease. Thus pulmonary apoplexy, a pneumonia of a few hours' duration, and a deposition of tubercular matter which has been proceeding for years, may occasion death in the same manner. It is thought by some that, independently of any change of structure, the lungs may be functionally unfit for the aëration of the blood, through a disordered supply of the "nervous influence" which is required for the process; but sound physiology does not warrant us in the belief that any such influence is necessary: nor is there any solid reason to believe that this function can be affected by any cause that

does not produce a change in the physical conditions which are evidently essential to its performance.

Having thus taken a general review of the principal causes which operate by *physical* means in the production of asphyxia, we may consider,

II. The causes which affect the *chemical* processes, to which the physical conditions are only subservient. These may be briefly dismissed. Of the several gases which may be introduced into the lungs, there are but a small number capable of producing simple asphyxia. Most of them have an immediate deleterious action on the system, quite independent of their negative properties, which consist in their want of power to afford oxygen to be absorbed or to remove the carbonic acid that is to be excreted. Hydrogen and azote are almost the only gases which can be regarded as simple asphyxiating agents. Both these may be breathed for some little time with impunity, even by man; and cold-blooded animals will exist in them for several hours or even days. By their physical properties they are enabled to remove the carbonic acid from the blood nearly as energetically as common air can do; but as they afford no oxygen, the animal must sooner or later perish for want of this stimulus. Oxygen breathed alone, however, is very deleterious to the system, which it over-stimulates. Other gases act as true poisons on the system, when introduced into it through the lungs; and their effects, therefore, are of a complex nature.

Phænomena. These vary, to a certain degree, with the *cause* of the suspended aëration of the blood; nevertheless, there are some which are universally witnessed, and to these our principal attention will be directed. They may be best observed when the asphyxia is *gradually* produced, as by a partial obstruction of the air-passages; when it *suddenly* comes on, they succeed one another so rapidly as not to admit of accurate observation. They may be divided into three stages. The *first* commences with an increase of that natural *besoin de respirer*, which prompts to the ordinary acts of inspiration; and this increases until it amounts to a sensation of extreme distress. In response to this extraordinary stimulus, active and powerful inspiratory movements are involuntarily performed; and muscles are excited to contraction, which do not partake in the ordinary duty. Other instinctive movements, more remotely conducive to the relief of the sufferings experienced by the individual, are sometimes performed by him at this time. The distress, which soon amounts, if not relieved, to intense agony, is of short duration; though it lasts longer if the aëration of the blood continue to a slight degree, than if the process be entirely suspended. It gives place to vertigo and a feeling of stupidity, which soon increases to absolute insensibility, which may be regarded as characterizing the *second* stage. The respiratory movements now become irregular and convulsive; and the other instinctive movements assume a similar character, the whole frame now partaking in them. Lividity of the countenance may sometimes be observed at the end of the first stage; it rapidly increases in the second, and especially affects the lips, which are often of a deep purple. The veins also become turgid; and the eyes are injected, and seem as if ready to start from their sockets. At this time the heart is found to be pulsating languidly, and the pulsation at the wrist is almost imperceptible. Very shortly all the animal functions are suspended; no farther muscular movements are performed, nor are any capable of being excited. The sphincters give way; and the animal, if previously erect, falls completely powerless. This is the third *stage*. The heart continues for a time to contract feebly; but the aëration of the blood is entirely suspended, and sufficient fluid is not propelled by it into the aorta to produce sensible pulsation of the arterial trunks. The general surface now partakes of the livid tint which first showed itself in the face; the hands and feet presenting a violet hue, and patches of a similar colour existing in other parts of the skin. The organic functions do not entirely cease until the circulation of the blood has been completely suspended; and even after somatic death must be regarded as having taken place, the temperature of the body is very slowly dissipated, and the *post mortem* rigidity of the muscles tardily supervenes. In fact recovery may take place even after the heart has ceased to act, if the proper means be employed.

The relative intensity of these phenomena will be affected by the cause to which they owe their origin; as will also, in some degree at least, the order in which they present themselves. The preceding description applies especially to those cases in which the deprivation of air is sudden and almost complete, as when due to an obstruction existing in the air-passages. It is in these that the inspiratory efforts are most laborious, and the sense of distress the greatest. Where, however, the cause be such as puts a stop to the muscular movements concerned in respiration, the fatal termination more rapidly comes on, and there is less of general disturbance. When the asphyxia is more gradually induced, on the contrary, the sufferings are often most distressingly prolonged. Thus, where it supervenes as a consequence of pulmonary disease, the dilated nostrils and livid cheek often indicate for a protracted period the existence of deficient aëration, whilst the patient's complaints of dyspnœa but too truly correspond with these symptoms. The feeling of distress is often referred to the lower part of the sternal region; and we have known counter-irritants applied to the spot with the view of relieving it, when the real malady was situated in the larynx. It is a point, therefore, of considerable practical importance, not to be hastily led to infer from local sensations the cause of the difficulty of respiration; this it may frequently exercise the skill of the physician to detect. It is when asphyxia slowly supervenes as a result of disease, that the greatest irregularity in the order of the symptoms is observable. A very high degree of lividity often shows itself long before the stage of insensibility has come on; and the latter is often preceded by symptoms of irregular action of the brain, such as vertigo, tinnitus aurium, flashings of light before the eyes, and various spasmodic actions. The subsequent convulsive movements are less violent; and the lividity of the face never acquires so deep a tint, although the discolouration is more general over the body. In these cases the action of the heart usually ceases soon after the respiratory movements have come to a stand; and this is the mode in which life very commonly terminates.

The time which is necessary to destroy life by asphyxia varies much, not only in different animals but in different states of the constitution of the same. Thus, warm-blooded animals are much sooner asphyxiated than reptiles or invertebrata; and, on the other hand, an hybernating mammiferous animal supports life for many months with an amount of respiration sufficiently low to produce speedy asphyxia if it were in a state of activity. And among mammalia and birds there are many species which are adapted, by peculiarities of conformation, to sustain a deprivation of air for much more than the average period. Excluding these, it may be generally stated, that if a warm-blooded animal in a state of activity be totally deprived of respiratory power, its muscular movements (with the exception of the contraction of the heart,) will cease within five minutes, often within three; and that the circulation generally fails within about ten minutes. Many persons, however, are capable of sustaining a deprivation of air for three, four, or even five minutes, without insensibility or any other injury; but this power, which seems possessed to the greatest degree by the divers of Ceylon, is only to be acquired by habit. The period during which remedial means may be successful in restoring the activity of the vital and animal functions, is not, however, restricted to this. Cases are not unfrequent of the revival of drowned persons after a submersion of half an hour; and more than one has been credibly recorded in which above three-quarters of an hour had elapsed. It is not improbable, however, that in some of these cases a state of syncope had come on at the moment of immersion, through the influence of fear or other mental emotion, concussion of the brain, &c.; and that, the circulation being thus enfeebled, the deprivation of air had not the same injurious effect as when this function was in full activity, just as in the case of an hybernating animal. Such a state has been denominated syncopal asphyxia. The reanimation of still-born infants has been successfully attempted when nearly half an hour had intervened between birth and the employment of resuscitating means; and when probably a much longer time had elapsed from the period of the suspension of the circulation.

Anatomical characters. In cases where death has resulted from simple asphyxia rapidly induced, the external appearances found on subsequent examination are usually very characteristic. The general lividity of the surface is not unlike that which is observed on the depending parts in other cases, but may be distinguished from it by not being confined to these situations. Moreover, it is often farther characterized by the presence of deeper spots, resembling those of ecchymosis. These are most commonly seen in the face and neck of persons who have been hung or strangled; and, on the other hand, they are usually absent in cases of drowning; but they are occasionally seen under other circumstances. The appearance seems to be the result of congestion of blood in the vessels of the skin, from which, indeed, the fluid appears sometimes extravasated; numerous points being observable when a section is made into the substance of that tissue. The features usually retain the expression of distress, and the eyes, as already noticed, continue prominent; the pupils are dilated, as in coma.

The accumulation of blood in the right side of the heart, and in the vessels, connected with it, namely, the systemic veins and the pulmonary artery, and the comparatively empty state of the left cavities, as well as of the pulmonary veins and systemic arteries, are the appearances most characteristic of asphyxia; and they are constant when this state has been completely developed. They are best marked, however, where it has slowly terminated life; especially when some degree of aëration has taken place up to its close, and the action of the heart has ceased within a short time. The coronary veins may often be observed to exhibit an extraordinary turgescence. Not only may the venous congestion be noticed in the vena cava and larger trunks, but it is very perceptible in all organs which are largely supplied with blood. Thus, the liver and spleen are in a state of engorgement; and the blood may be forced out in large drops by slight compression of their parenchymatous tissue. The intestinal membranes, too, are observed to be excessively congested, especially in the most depending parts; and ecchymosed spots are not unfrequently seen on the mucous membrane of the stomach after strangulation, constituting a variety of pseudo-morbid appearance, which the inspector will do right to bear in mind. This tendency to congestion in the venous system, which so constantly accompanies deficient respiration, has a most important influence on the condition of various organs in the later stages of chronic diseases of the thorax; and it readily explains the derangements which they are liable to exhibit. Even the heart not unfrequently suffers from the same cause; a permanent distention of its right ventricle, with hypertrophy of its walls, being a frequent concomitant of obstructed respiration; of which particular instances will be hereafter given.

The blood is usually found fluid, or but imperfectly coagulated, if the asphyxia have been rapid; and this corresponds with what is observed after other kinds of sudden death. Where it has more slowly supervened, the blood coagulates as usual.

The veins and sinuses of the head of course partake of the general venous congestion; and, in well-marked cases, an unusual number of red points are seen on slicing the brain. The distention is greatest where the previous struggle has been most severe, or where there has been a peculiar obstruction to the return of the blood from the head, as in hanging or strangulation. There is seldom, however, any morbid effusion; but an apoplectic extravasation is sometimes found, though rarely as a consequence of simple asphyxia. In cases where there has been but little general disturbance, the vessels of the brain and its membranes are found to be in their natural state.

The venous congestion is usually well marked in the root of the tongue, which often appears as if injected, the papillæ being remarkably prominent. It extends also to the mucous membrane of the larynx and epiglottis, of the trachea and bronchi, which is deeply coloured by vascular turgescence, and which becomes darker as it is traced into the smaller ramifications of the bronchi. The mucus which covers its surface is generally mixed with a frothy serous exudation,

usually exhibiting a sanguinolent tinge. This effusion, which is often very abundant where the obstruction to the respiration has gradually operated, seems to result from the congested state of the vessels, and not to be an altered form of the natural secretion, as some have supposed. The fibrous tissue which unites the cartilaginous rings of the trachea and bronchi is also injected with blood. The lungs themselves, if not previously diseased, are greatly distended, and expand so as to meet over the pericardium. When exposed to view, they present a dark brown, sometimes almost blackish, hue externally; but their parenchyma exhibits a redder tint when cut into. The engorgement is here in the arterial system; but it is occasioned by the accumulation of venous blood, of which large dark, thick drops flow out when incisions are made in the substance, and slight pressure employed.

Pathology of Asphyxia. There can scarcely be a more remarkable illustration of that important truth that morbid anatomy furnishes but one class of the facts upon which the science of pathology must be erected, than that presented to us in the inquiry which we have now to make into the nature of the morbid action which results from the derangement of the respiratory function, and the mode in which this occasions death. There is no dispute as to the leading facts supplied by anatomical examination; but in the interpretation of those facts there is much scope for discussion. No satisfactory conclusion can be attained, unless a clear conception be first formed of the physiological or normal action of the organs whose deranged function is the subject of investigation. We particularly refer to that of the capillary vessels of the lungs, the duties of which must, it is obvious, be the first deranged by any cause which obstructs the access of air to the respiratory membrane. It is in these vessels that the character of the blood is altered from the venous to the arterial; and to be subservient to this change is their peculiar function, just as the secretion of fluid is the function of the capillaries of glands, and nutrition that of the capillaries of the system in general. That the movement of the blood through them is principally dependent, in their usual condition, upon the action of the heart, does not admit of a doubt; but it seems equally certain that for the continuance of this movement, the continuance of the changes to which it is subservient is essential; and that not even the powerful contractions of the heart can force the blood into the pulmonary veins, when these changes are suspended. The condition here assigned to the maintenance of the capillary circulation does not apply to that of the lungs alone. It corresponds with that which we find by observation and experiment to hold good in reference to the capillaries of the whole system. We need not imagine that any mechanical propulsive power exists in them, in order to understand how such an influence on the movement of the blood through their canals may be exercised by their parietes; since it is easy to conceive that new attractions and repulsions between the solid and fluid particles may be created by the processes to which they are subject. This is not the place to discuss such a question, however; the correctness of the view just stated, in its application to this particular topic, will, we think, appear from the facts to be presently adduced; and a fuller elucidation of it will be found in the physiological division of this work. If its validity be assumed, it will follow that the first effect of impeded respiration will be a retardation or cessation of the passage of blood through the capillaries of the lungs; and that this impediment will be the cause of all the other phenomena which are observed in the progress of the complaint, and finally of its termination in death. Before proceeding to develop this view in detail, however, it will be desirable to glance at the principal theories which have been offered as explanations of the same facts, and to inquire briefly into their value.

It would be scarcely necessary to mention the doctrine propounded by Haller, since it received a most complete refutation from Goodwyn, were it not that he assigned the true situation for the commencement of the morbid changes, although he misunderstood their nature. In his opinion, the stagnation of the blood commenced in the capillaries of the lungs, and thence affected the whole venous sys-

tem; but he imagined this stagnation to arise from a *mechanical* impediment, produced by the cessation of the motions of the lungs themselves. It is a sufficient reply to this doctrine, that all the phenomena of asphyxia are as completely developed in an animal which is made to breathe azote, as in one which has been drowned or strangled; and it was pointed out by Goodwyn, that after the fullest expiration, the air-cells do not return to the state in which they were in the new born child, but are sufficiently distended to permit the blood to circulate freely through them. In fact, as will be subsequently shown, any excess of distention is unfavourable to the passage of fluid through their capillaries. The theory of Goodwyn himself was, that whilst venous blood furnishes to the right cavities of the heart the stimulus which excites them to contract, the fibre of the left side requires a more powerful stimulus,—that of arterial blood; and in default of this, ceases to perform its functions in maintaining the systemic circulation, no longer contracting upon the blood returned to it from the lungs, when this has not been arterialized. This hypothesis, however ingenious, is inconsistent with several observed facts. Were it correct, the pulmonary veins and left auricle ought to be found loaded with blood, which is not the case. Moreover, the left side of the heart continues to contract upon blood which may almost be called venous, in hibernating animals, whose respiration is so trifling; and Bichât proved experimentally that venous blood might be injected into the left cavities of the heart, with the effect of exciting, not depressing, their action. He also ascertained that venous blood is propelled into the systemic circulation of an animal undergoing asphyxia; so that the doctrine of Goodwyn may be regarded as completely disproved. We do not mean to assert, however, that venous blood is as effectual as arterial in stimulating the left side of the heart; but that it is sufficiently powerful for the maintenance of the actions of that portion of the organ so long as it is supplied, is evident from the fact that its chief cavity and the vessels connected with it are never found to contain more than a comparatively small quantity of blood.

The theory of Bichât is the one which, until recently, has gained the most general assent; and there can be no doubt that it is partly based on truth. That it does not accord with *all* the facts of the case, however, and cannot, therefore, be regarded as a satisfactory explanation, will presently appear. He ascribed the cessation of the circulation to diminished irritability of the heart, resulting, as he supposed, from the deleterious effect of its penetration by venous blood upon its vital properties, an effect which he proved this fluid to exert on the excitability of the nervous system. This doctrine, as well as that of Legallois (who supposed the irritability of the heart to be destroyed by the circulation of venous blood in the spinal cord,) is open to the same objection as that already brought against the theory of Goodwyn; which is one that will apply to any theory which primarily refers the cessation of the circulation to want of power in the heart; namely, the empty state of its left cavities, and the renewal of its action, after it has entirely ceased, by a cause which does not immediately affect it. Bichât, indeed, foresaw these objections. Of the second he attempted to dispose by asserting that artificial respiration never renews the action of the heart when it has entirely ceased—a statement opposed by well-ascertained facts. Of the first, he has given no satisfactory explanation. Moreover, his opinion that the circulation of venous blood through muscles is destructive of their irritability, is contradicted by the experiments of Dr. Kay (*Treatise on Asphyxia*, p. 50,) who found that the exhausted irritability of muscles was restored when venous blood was made to circulate through them, but remained extinct if no fluid was transmitted. Some of Dr. Edwards experiments also lead to a similar conclusion; namely, that venous blood, though less powerful than arterial in maintaining the vital properties of muscles, is by no means rapidly destructive of them.

That the first impediment to the circulation of the blood in asphyxia is occasioned by an obstruction to its passage through the pulmonary capillaries, might be inferred simply from the progressive accumulation of the fluid in the system

of vessels, of which those channels form as it were the outlet; a phenomenon constantly observed in this condition, and more or less rapidly induced as the aërating process is more or less completely suspended. It has been maintained by some that the blood flows freely into the pulmonary veins, and is thence carried into the general current of the circulation, until its deleterious action has been exercised on the nervous centres; and that, from a sort of paralysis of the capillaries of the lungs, the flow of blood through them is *then* impeded. But this view is inconsistent with the fact of every day occurrence, that a great degree of venous congestion may occur long before the blood in the arteries has become sufficiently loaded with carbon and deficient in oxygen, to produce insensibility by its action on the brain. Moreover, the doctrine that "nervous influence" is essential to the flow of blood through the capillaries of the lungs, or of any other part, is a mere assumption, unsupported by physiological facts. On the contrary the recommencement of the circulation through the capillaries of the lungs, when oxygen is brought in relation with them, *before* any alteration has taken place in the character of the blood in the vessels of the brain, sufficiently proves that it is in them and them alone that we are to look for the primary cause of obstruction, and the cause of the recommencement of the circulation. What, then, is the nature of their influence on the movement of the blood through them? That it is not mechanical is sufficiently proved by observation; for no regularly alternating contractions and dilatations have ever been seen by the microscope in these vessels; and the only mode in which a change in their caliber would seem to influence the current is by such relaxation as may give it free passage, or such contraction as may impede it. The latter state is the one which would seem primarily to result from the application of any stimulus, as is shown both by microscopic examination and by the experiments of Wedemeyer, who found that stimulating liquids injected into the arteries of living animals were much longer than mild liquids in finding their way into the veins. The state of relaxation is that which *paralysis* or *want of tonic action* would seem to produce; and it is therefore impossible to attribute to either of these causes the cessation of the movement of blood in the pulmonary capillaries, which is consequent upon suspended respiration.

A more valid and consistent explanation may be found in the cessation of those changes to which the passage of the blood through the capillaries of the lungs is subservient. How the movement of the fluid is dependent on their continuance, it may not perhaps be easy to explain; but the fact seems well established by direct evidence, and coincides with what we know of the laws of vital action in general. In the lower animals, as in plants and in aëricæ fœtuses, the circulation is almost entirely independent of any central propulsive organs, and is chiefly maintained by powers originating in the capillary vessels; and even where a distinct and powerful heart is developed, we find that the distribution of blood to different organs is governed more by the relative activity of the processes taking place in them than by any other cause. Any circumstance which peculiarly excites the nutritive or secretory actions of a texture or gland will occasion a determination of blood towards it, which is quite independent of any alteration in the heart's action; and on the other hand, any depression of their natural actions will produce a corresponding diminution in the amount of blood transmitted through them, with which the heart has no concern. The fact, then, seems to be, that any impediment to the arterialization of the blood in the pulmonary capillaries will *of itself* impede its motion through them; and this in proportion to the completeness of the obstruction. It is quite true that when the access of air to the lungs is suddenly and completely checked, the circulation through them continues for some little time; and that blood of a partly venous character is transmitted into the systemic arteries. But it is to be recollected that a considerable quantity of air is contained in the air-cells of the lungs; and that it is not until this has been so far deprived of its oxygen and loaded with carbonic acid, as to be unfit to effect any change on the blood, that we should expect the movement to be entirely checked. More-

over, the alteration in the character of the whole mass of the circulating fluid is effected gradually, as might be inferred from the small proportion transmitted by the heart at each contraction; so that, if a small stream be drawn from the carotid artery of an animal undergoing asphyxia, it will be seen to become progressively darker, from the commencement of the suspension of the respiratory movements to the cessation of the heart's action. If, then, an interruption of the chemical changes effected in the pulmonary capillaries be the cause of the stagnation of the blood in them, a renewal of those actions ought also to renew the movement; and this it has been experimentally demonstrated to effect, in a sufficient number of cases, and under a great variety of circumstances, provided that the suspension have not been so prolonged as to occasion a loss of the vital properties of the organism. To these cases we shall presently return.

We may consider it sufficiently proved, then, that the stagnation of blood in the capillaries of the lungs is the primary effect of suspended aëration; and we have now to inquire into the mode in which this disturbance of the current of the circulation affects other organs, especially the heart and nervous system. It is very evident that the accumulation of blood in the right ventricle must soon become a mechanical impediment to its contraction; and the distention at last appears to impair or even destroy its irritability, just as in the case of the bladder. There is no doubt, however, that the permeation of its texture by venous blood will affect its contractility; but that it is still able to propel its contents, if the distention be slightly relieved, is shown by the recommencement of its action when the renewed movement of the blood in the capillaries of the lungs diminishes the engorgement of the pulmonary arteries, and by the effect of more direct evacuation, as will be presently noticed. The left side of the heart, on the other hand, gradually ceases to act from an opposite cause—the deficiency of blood. It has been proved by the experiments of Drs. Williams and Kay that its contractility is retained until after the pulmonary veins have ceased to return sufficient blood to excite its action. When rabbits were asphyxiated by tying the trachea, it was found that the flow of blood from a divided artery almost ceased at the end of the third minute, and was entirely suspended at the fifth; yet “the left heart contracted spontaneously for a very considerable period longer.” And when the left auricle was examined under similar circumstances, it was found that after a period of three or four minutes very little blood was returned by the pulmonary veins, though the heart still acted vigorously. “In general,” says Dr. Kay, “the phenomena of the cessation of motion in the left heart in asphyxia are these:—a smaller quantity of blood is received into its cavities, and expelled for a time vigorously into the arteries; the ventricle meanwhile diminishes in size, as the quantity of blood supplied becomes less, until at length, although spontaneous contraction still occur in its fibres, no blood issues from a divided artery, and the ventricle by contraction has obliterated its cavity; after this, blood slowly accumulates in the auricle from the large vessels of the lungs; and its contractility continues for a very considerable period.” (*Edin. Med. and Surg. Journ.* vol. xxix. p. 46; and *Treatise on Asphyxia*, p. 135.) So long as the contractility of the left ventricle is retained, although its movements may have entirely ceased, it may be excited to renewed action by a supply of the necessary stimulus; and thus it may be revived, and the general circulation restored, by artificial respiration which, by unloading the right cavities, and filling the left, furnishes the required conditions.

There is no difficulty, then, in understanding how the entire circulation may be brought to a stand by a cause acting immediately upon the capillaries of the lungs. We have next to inquire into the mode in which those phenomena are produced which indicate an affection of the nervous centres;—namely, the vertigo, delirium, spasms, and insensibility which mark the later stages of asphyxia. These have been usually attributed, and with much show of reason, to the circulation of imperfectly arterialized blood through the vessels of the brain and spinal cord. In most vertebrated animals we find a provision for sending to

the head the most highly-aërated portion of the general mass of nutritious fluid. The provisions for this purpose are most apparent in the class of reptiles; but they are also peculiarly manifest in the embryo state of birds and mammalia. It is evident, then, that of all organs of the body, the nervous centres are the most dependent upon a constant supply of pure arterial blood, for the due performance of their functions. But the *quantity*, as well as the *quality*, of the circulating fluid seems to have an important influence. The brain is well known to receive a proportion of the whole amount of blood, far beyond that to which its relative bulk would entitle it; and any interruption to the supply is found to have an immediately injurious effect upon its functional activity. Thus, Sir A. Cooper has shown, that if the carotid arteries be tied, and the vertebrals be compressed, a state resembling syncope immediately supervenes. We may reasonably infer, then, that the insensibility of asphyxia may arise from the concurrent action of both these causes—deficient supply, and depravation of quality. The deleterious influence of the circulation of venous blood through the cerebral arteries was proved by an experiment of Bichât. He injected venous blood from the heart of one dog into the carotid of another, and insensibility was the result; but, on the other hand, it has been shown by Dr. Kay that large quantities of venous blood might be injected into the carotid arteries without producing more than muscular debility and lassitude, provided the injection be made slowly and cautiously, so as not to produce mechanical injury of the cerebral matter, by distention of the vessels. In one of his experiments (*op. cit.*, p. 195) an accidental circumstance occasioned the employment of considerable force; the animal struggled and its limbs quivered, but it seemed to recover for a time, though it remained feeble. It afterwards exhibited symptoms of lesion of the brain, and died at the end of ten days, from the effects of an abscess in one of the hemispheres. There is no difficulty, then, in accounting for the immediate insensibility produced by Bichât's injections. From the results of Dr. Kay's experiments it may be inferred, that "though venous is a much less stimulating fluid than arterial blood, it may circulate through the cerebral mass without producing by its *contact* with the brain a sudden suspension of the functions of the nervous system. I conceive that it must be regarded as a fluid capable of only slightly nourishing and stimulating the nervous system. Its presence in the vessels of the brain, even for a short time, occasions languor and feebleness; and if its circulation were prolonged, we may imagine that sensation and voluntary motion would become still farther impaired; but it does not destroy life by contact with the brain, and in asphyxia small quantities of it are transmitted, and for a short period only, to the cerebral structure." (*Op. cit.* p. 198.) The sudden insensibility of asphyxia is, therefore, to be in part attributed to the rapid diminution in the amount of the blood sent to the brain; and a state by no means dissimilar is often witnessed in cases of hæmorrhage, in which deficiency of the nutritious fluid is the *only* cause in operation: neither change alone would produce the train of phenomena formerly described; this results from a combination of both. We have already observed a similar combination of influences in the suspension of the heart's action; and our attention is thus forcibly directed to the fact that when any link in the chain of vital phenomena is broken, and the equilibrium of the whole disturbed, the derangements which ensue are so various and complicated, that it is difficult to assign to each its peculiar agency in finally producing the fatal termination.

It is obvious, that the state of deep coma, once induced, will hasten death in those cases in which a small amount of respiration was previously going on, by the suspension of the muscular movements necessary to it. But even after this has supervened, and the *animal life* of the being has ceased to manifest itself, the organic life may be maintained for a considerable period; its duration depending upon the intimacy of the connexion between the two classes of functions at the time. Thus, although the destruction of the brain and spinal cord (by which a state corresponding with profound coma is induced) occasions speedy death under common circumstances, Dr. M. Hall has shown that it may be performed in an

hybernating animal, without extinguishing the heart's action, for many hours. Again, this connexion cannot be said to be established in the new-born animal until the first respiration has taken place; and before this has occurred, life may be prolonged for a considerable time under submersion in warm fluid. Thus, Buffon found that greyhound puppies appeared to have suffered little, after being immersed in warm milk for half an hour; and Legallois found the mean duration of life in full-grown fœtuses of rabbits, immersed in water, to be twenty-eight minutes. After the animal has respired for a short time, however, this power of resisting the want of air diminishes very rapidly; and in those species which generate a large amount of heat soon after birth, such as the guinea-pig, this power is scarcely greater in the new-born animal than in the adult. These different conditions, natural to the lower animals, find a parallel, to a certain degree, in peculiar states of the human economy induced by disease, especially those in which syncope partakes.

When the causes of asphyxia were being enumerated, it was pointed out that it is the natural tendency of many internal diseases, as well as of various external agencies, to induce this condition. We may now go farther, and state what will to many appear startling, that in a very large proportion of deaths, natural as well as violent, gradual as well as sudden, the event is either immediately or remotely attributable to this cause. It must be remembered that, so long as the circulation is maintained, the life of the system must be regarded as continuing, even though the animal functions should have ceased to manifest themselves; and if the causes which can operate in suspending this movement be considered, they will be found to act in one of three ways; either by destroying the moving powers, which have their seat in the heart and capillary vessels: by occasioning an obstruction in some part of the channel, which shall affect the whole current, and not a part of it merely: or by withdrawing the vital fluid itself. In the first of these cases, death is said to take place by *syncope*; and the same term includes the last also. Few causes but *asphyxia* can operate in the second mode, since no stagnation of blood in any other organ than the lungs can suspend the general current of the circulation, and a similar effort could only be produced by a complete obstruction of the aorta or pulmonary artery. It is therefore desirable to review briefly the principal morbid conditions which terminate in death through the medium of asphyxia, as well as to notice others which the continuance of imperfect respiration would be liable to produce.

Of the former, one of the most common is the state denominated coma or stupor, which results from some change in the healthy condition of the brain and spinal cord. When this is profound, it suspends the respiratory movements, as formerly mentioned, by interrupting the channel through which the stimulus conveyed by the afferent nerves acts in producing them. All diseases and injuries which terminate in coma, do in reality, therefore, occasion death by asphyxia. This principle is a very important one, since it leads us to take means for the maintenance of respiration when the cause of the stupor is temporary only;—an indication which has been successfully acted upon. Thus, Sir B. Brodie found that animals rendered insensible by narcotic poisons might have their lives preserved by artificial respiration, kept up until the functions of the brain were restored; and the same expedient has been practised with success on the human subject. Although it would be evidently useless where the coma is a result of permanent organic lesion, it is by no means impossible that it might be successful in some cases of insensibility with convulsions in children, resulting from some temporary cause, which might subside if the circulation could be carried on for a sufficient length of time, especially if life were enough prolonged to allow of the operation of remedial agents. It must not be supposed, however, that all causes acting through the nervous centres produce death through the medium of asphyxia: since there are many which rather occasion syncope, depressing the general vitality of the system, destroying the contractility of the heart, and the peculiar properties of the capillaries, as by a sudden and general shock, which

seems diffused through the nervous trunks to every part. It is in this manner that concussion, and other violent mechanical injuries to the brain, occasion the immediate cessation of the movement of the blood, which is not prolonged for an instant beyond the cessation of the movements of respiration. There is a form of apoplexy, the *apoplexia fulminans* of old authors, denominated by French writers *apoplexie foudroyante*, in which the effusion of blood acts instantaneously in the same manner as a mechanical shock; whilst the mode in which this disease ordinarily becomes fatal is by suspending the respiratory movements alone. It seems probable that when death results from exposure to cold, it is at last by asphyxia induced by coma. It does not appear very clear, however, to what the coma is to be attributed; nor is it certain that the injurious influence of cold as a sedative to all vital actions is not directly exerted in checking the circulation, by depressing the powers of the heart and capillaries. The connexion of obstructed circulation through the lungs with diminished sensibility of the nervous centres, should not be forgotten in the consideration of the phenomena of fever. It is well known that in typhoid states of this disease, in which coma is threatened, dyspnoea is a very frequent occurrence, and that this is accompanied by a considerable effusion of fluid into the parenchyma of the lungs, without any decided symptoms of active disease in these organs. The continuance of this state will of course favour the complete production of coma; but a sound pathology will teach us to direct our remedial means rather towards the head than the chest.

The diseases which have a tendency to produce asphyxia by directly preventing the access of air to the blood have already been pretty fully indicated: but it must be remarked, that when these are very chronic in their form, they do not produce death by asphyxia simply, but by such a general wasting of the powers which move the blood, that it may be said to partake of the nature of syncope. It is in cases of violent and sudden death that the distinctions above made are most easily recognised; the termination of protracted disease, if observantly watched, will generally present phenomena partaking of all the forms which may separately manifest themselves in particular cases. The intimate dependence of all the organic functions with one another, and the degree in which every one may be influenced by the nervous system, often cause them to be affected by disorder of any one, in a manner which at first sight appears anomalous, but which a little consideration will generally elucidate.

We have hitherto considered asphyxia only in its fully developed form, and examined only its fatal termination. It must not be forgotten that imperfect respiration has a tendency to produce various diseases, although it may not be sufficient for the immediate extinction of life. The recent experiments of Dr. J. Reid (*Edin. Med. and Surg. Journ.*, April, 1839) have shown that, when the number of inspiratory movements is greatly diminished by section of the pneumogastrics, the sanguineous engorgement of the lungs which is thereby produced is very apt to pass into the state of inflammation; and that the various stages of pneumonia, and even gangrene, are very commonly witnessed in animals which have lived sufficiently long after the operation for these changes to take place. The most constant result of this engorgement is an effusion of serous fluid into the air-cells and passages, which, of course, adds to the difficulty of respiration. It may, then, be reasonably surmised that there is a tendency to similar morbid changes in other cases of obstructed respiration; and this has been noticed in a variety of instances. Thus, when foreign bodies have remained impacted in the air-tubes, but have not produced immediate suffocation, inflammation of the lungs is very apt to supervene: and bronchocele not unfrequently proves fatal in a similar manner, whilst the real obstruction is still inconsiderable and does not excite attention as the cause of the disease. The permanent congestion of the pulmonary arteries, and the demand for increased propelling force, will often occasion hypertrophy and dilatation of the right ventricle; and the same congestion, extending to the systemic veins, may be the cause of many diseases in remote organs, especially the pain,

liver, intestines, and kidneys. Dropsical effusions, also, are very liable to occur from the same cause. It is perhaps during the progress of phthisis that we most frequently observe these consequences of partial asphyxia. The bronchitis which so commonly accompanies chronic tubercular disease of the lungs may be not improbably regarded as taking its origin in the congestion of the mucous membrane of the air-passages, which has been mentioned as a constant result of obstructed respiration; and the attacks of active inflammation of the lungs themselves, which are so liable to supervene whenever deposition of tubercular matter has taken place, may, without doubt, be in part attributed to a similar predisposition. The diarrhœa which so commonly occurs in the later stages of the complaint may be accounted for in a similar manner. It is often found on *post mortem* examination that no morbid change has taken place in the mucous membrane of the alimentary canal or in the intestinal glands; and its functional disorder may be attributed to the irritable state induced by the congestion which has affected it during life, and which has been mentioned as often so remarkable a feature in the appearances found after death from asphyxia. Even where ulceration of the intestinal glands, and softening of the mucous membrane, are found to have taken place, they may be regarded as having had their origin in the disturbance of the circulation so often alluded to.

Treatment. The ideas which are entertained of the nature of asphyxia must necessarily have an important bearing upon the principles of treatment. Those which will be here stated have been for the most part fully sanctioned by experience; and will, at the same time, be found to harmonize well with the theoretical views formerly stated. It is rarely that this condition comes under the notice of the physician in any other form than as secondary to other diseases; but as he should not be ignorant of the share it has in various kinds of *violent death*, we shall presently consider the principal forms under which it may present itself, and the treatment specially adapted to each.

The first object in the treatment of asphyxia will evidently be to remove its cause; since, as long as this continues to operate, no permanent relief can be procured by any means whatever. This precept will apply not only to the removal of direct or mechanical obstructions, but to the abatement of all sources of interference with any of the operations naturally concerned in the function, and especially those of the nervous system. When the derangement has not advanced so far as to occasion cessation of the respiratory movements, it will usually be found that this measure will restore the due action of the whole train in a very short time, provided that no organic lesion, such as extravasation in the brain, has taken place. But where these have been suspended, more active means become necessary. It will be remembered, that not only is there a suspension of activity under such circumstances, but an absolute diminution of the vitality or irritability of all the organs concerned, occasioned by the previously insufficient supply of blood, and by the want of oxygenation in that which has been last transmitted. The indications of treatment, therefore, are two; the renewal of the respiratory actions, and the excitement of the low irritability of the system by unusual stimuli. The first is effected by artificial respiration, which is undoubtedly the most powerful means in our possession of restoring suspended animation under such circumstances. Its success, however, will mainly depend upon the care and judgment with which it is employed. As little time as possible should be lost in putting this measure into execution; but whatever interval should from necessity occur, may be advantageously employed in other ways to be presently noticed. Until more appropriate means are available, the natural movements of respiration may be in some degree imitated, by compressing the chest and abdomen, so as to diminish the cavity of the thorax, and to expel from the lungs as much as possible of their contents, and then allowing them to recover their former dimensions by their natural elasticity. Although but a poor substitute for the natural process, even this trifling assistance may be of the utmost benefit, if given at the critical time when the heart's action is nearly suspended, and the vital powers rapidly

sinking. Where no bellows can be procured, the insufflation of the chest from the mouth of another is the best measure that can be adopted. It would, in fact, be preferable, on account of the higher temperature at which the air is thus introduced, and the security which is afforded against the employment of an injurious degree of force, were it not for the partial carbonization and abstraction of oxygen which this air has undergone. The insufflation is performed by applying the mouth of the operator to the mouth or to one of the nostrils of the patient, closing the other apertures, and making a forcible expiration, so as to dilate the chest which is then to be emptied again by gentle pressure. The insertion of a short tube into the nostril, if of sufficient bore, will much facilitate the operation. It will be desirable that an assistant should at the same time gently press the larynx backwards and a little downwards upon the vertebræ, so as to oppose the passage of air through the œsophagus into the alimentary canal. When a pair of bellows is employed, the air should be injected through one nostril, whilst the mouth and the other nostril are closed: the latter is then to be opened for the expiration of the air,* and the process repeated about fifteen times in the minute. With regard to the amount of air to be thus introduced at each stroke, there is some difference of opinion. Goodwyn, although he estimated the quantity naturally taken in at each inspiration to be no more than twelve cubic inches, recommended that a hundred cubic inches should be thrown in by the bellows, for the dislodgement of the impure air from the air-cells and smaller bronchial tubes, which he thought could not be otherwise effected. There is no doubt, however, that if this principle were followed, irreparable injury would result from it to the texture of the lungs; indeed, there is reason to believe that many individuals have been sacrificed by injudicious insufflation who might otherwise have recovered. Leroy discovered that brisk inflation of air into the trachea killed rabbits, foxes, goats, sheep, and other animals, even when the force employed was that of an expiration from the human being; and the recent experiments of Dr. Southwood Smith (*Philosophy of Health*, vol. ii. p. 75,) have shown, that though a moderate inspiration favours the passage of the blood through the lungs, great distention of their cavity checks almost entirely the circulation of fluid through them, by the mechanical compression of the vessels. According to Leroy, the quantity injected ought to be the same as that naturally inspired; and this is the safest rule. A few repetitions of the process will soon produce an entire exchange of the air contained in the lungs, by the tendency to mutual diffusion of which all gases partake; and it is better that no risk should be run of doing mischief where the organs concerned are of so delicate a conformation. Moreover, the insufflation of too large a quantity of air will diminish rather than increase the development of caloric; and this is the explanation of the results which have led to the belief, that artificial respiration has no power of maintaining animal heat. The respiratory movements may also be excited by galvanic action on the muscles, in the method proposed by Leroy and approved by Magendie (*Journ. de Physiologie*, tom. ix.;) and there can be no doubt that the penetration of a fresh atmosphere into the air-cells will be more facilitated by such a process, than by insufflation. This method requires little skill for its employment, and is unattended with any danger; and it is thereby superior to that of Dr. Ure, which can only be carried into effect by a person possessed of considerable anatomical knowledge. Leroy introduced acupuncture needles a short way into the fibres of the diaphragm on each side, in such a direction that they might be easily connected with the opposite poles of a galvanic battery. When the galvanic circle was completed, the diaphragm contracted and enlarged the cavity of the thorax: when it was interrupted, the weight of the abdominal viscera, assisted by gentle pressure on the surface,

* The bellows constructed under the direction of the Royal Humane Society is provided with an additional valve for this purpose, which prevents the necessity of the alternate closure and unclosure of the nostril.—AUTHOR.

caused its return; and thus alternate movements of inspiration and expiration were produced, and maintained until the natural movements supervened. A small galvanic apparatus only is sufficient for this purpose.

The second indication for treatment is the exhibition of various stimulating agents, both internally and externally. Amongst the most powerful and useful of these is warmth; but some judgment is required in its application. If the circulation have ceased, and the temperature of the body be much lowered, no attempt should be made to raise it suddenly; since experiment shows that when such attempts are made on animals in a state of torpor, they are often fatal. Warmth may be gradually communicated by means of a warm bath, or by warm applications, especially to the region of the stomach; but no fluid of a temperature above 98° or 100° should be employed. Rubefacients also may be applied to the skin with advantage, and friction employed, when it has in some degree recovered its sensibility; but they are previously useless. Warm stimulating fluids in moderate quantity should be injected into the stomach or rectum, and stimulating vapours applied to the nostril.

When not only the respiratory movements but the actions of the heart have ceased, the case becomes much more serious, but it is not entirely hopeless. It has been already stated that artificial respiration has proved successful in renewing the circulation by unloading the right cavities of the heart and transmitting the necessary stimulus to the left. But this is unfortunately not often the case; and it is therefore to be considered what auxiliaries can be employed. Slight shocks of electricity, or a current of galvanism, transmitted through the regions of the heart, would appear the most likely means of re-exciting its contractions. Another method has been pointed out, however, which is well deserving of trial. Professor Coleman found that after animals had been asphyxiated, and the right auricle had lost its irritability, the detraction of a small quantity of blood from one of its veins occasioned it in few minutes to respond to the application of a stimulus (*Wilson on the blood*, p. 131.) A similar fact was observed by Dr. J. Reid in experimenting upon the action of certain poisons. A slight incision into the auricle itself appeared most effectual; but the opening of the jugular vein generally produced the same effect. This measure is likely to be useful in more ways than one, since it will relieve the congestion of the cerebral veins, and thus promote the recovery of the sensibility. It is not a step, however, to be indiscriminately adopted. The inquiries of Mr. King (*Safety-valve Function of the Heart*, in *Guy's Hospital Reports*, vol. ii.,) leave us no difficulty in understanding how an abstraction of blood from the jugular vein may relieve the distention, not only of the right auricle, but of the ventricle, since the tricuspid valve does not close so as to prevent regurgitation, when the accumulation of blood is considerable. The effect of an electric or galvanic stimulus should be first tried; and if it fail, the experiment should be repeated after the abstraction of a little blood from the jugular vein as low in the neck as possible.

Attempts at resuscitation should not be abandoned as hopeless until many hours have elapsed, unless evident indications of death present themselves; nor should the employment of remedial means be discontinued at too early a stage of recovery. The condition of the patient, even after the natural movements of respiration have recommenced, and the circulation has been renewed, is very precarious, and requires watchful attention for a considerable time. Many lives have been sacrificed by too early neglect.

The object of the preceding sketch has been rather to give a general view of the whole subject of asphyxia, and especially to exhibit the connexion of this pathological state with other morbid conditions of the system, than to pursue any department of it into details.

We shall now inquire how far it is concerned in two of the most common forms of violent death,—strangulation and submersion: these, however, will be here considered simply in a pathological view; their juridical relations will be fully treated of in the division of this series appropriated to forensic medicine. One form of

asphyxia which has been but slightly adverted to in this article, the *Asphyxia neonatorum*, will be more fully treated of among the diseases peculiar to infants.

We shall now consider the phenomena attending certain forms of *violent death*, in the production of which asphyxia is principally or solely concerned.

Strangulation. By this term is understood forcible compression of the neck by a ligature, to such an extent as to impede or prevent respiration. *Suspension* is, therefore, but one variety of strangulation, the peculiarity of which consists in the traction of the ligature being produced by the weight of the body. In the simplest form of suspension the phenomena are precisely the same as those of ordinary strangulation; this takes place where the body is lifted from the ground by traction of the cord, and where no violent jerk is given to the neck. But this seldom happens; for in most cases of suspension the body has been made to fall more or less violently, so as to occasion other injury besides the simple compression of the neck in which strangulation properly consists. We shall first, then, consider the phenomena of death by *strangulation* simply; and afterwards those which often attend death by *suspension*.

If the compression of the neck affected only the trachea, it is obvious that death would be produced by asphyxia solely; and in this manner it has been occasionally brought about,—some firm substance, like the cushion of a tourniquet, having been applied upon the windpipe. A mode in which infanticide has been sometimes perpetrated—the firm and continued pressure of the thumb upon the trachea—operates in precisely the same manner, although hardly referrible to the head of strangulation, from the absence of ligature. On the other hand, it is easy to conceive that a ligature may be applied around the neck in such a manner as to make injurious pressure on the jugular veins, so as to occasion death by cerebral congestion, or by apoplexy simply, without materially obstructing the respiration. And again, it is sufficiently evident that, in most cases of strangulation, both these circumstances will operate in producing the fatal result. Accordingly it is found, by examination of the bodies of those who have died by strangulation, that in a few cases the signs of asphyxia alone are present; in some those of apoplexy alone are very decided; and in a large proportion the appearances indicate that both states have existed. Out of 102 cases collected by Remer (*Annales d'Hygiène*, tom. iv. p. 179,) unequivocal signs of apoplexy were found in nine; the appearances resulting from pure asphyxia in six; a combination of the two in sixty-eight; and in the remaining nineteen the proximate cause of death was not substantiated. More recently Dr. Casper (*Wochenschrift für die gesammte Heilkunde*, January, 1837,) has given a similar collection of the results he has obtained, of which the following is a summary. Out of 106 cases, death appears to have taken place by apoplexy in nine; by simple asphyxia in fourteen; by both conditions in sixty-two; from neither in five; and the number of unexamined bodies was sixteen. In several of the cases attributed by Remer to apoplexy, there seems to have been (although not distinctly stated by him) an extravasation of blood in the brain, as well as congestion of the cerebral vessels: in those related by Casper, on the other hand, the congestion alone seems to have been too much relied on as a sign of apoplexy, since it is to be recollected that distention of the veins of the brain occurs in asphyxia. It can scarcely be doubted that these variations depend principally on the mode in which the ligature is applied to the neck; and a series of experiments upon his own person was performed by Dr. Fleischmann (*Annales d'Hygiène*, tom. viii. p. 432,) with the view of elucidating this question. Although not entirely satisfactory, they afford some important results, of which we shall give an abstract.

1. If the neck be encircled with a ligature placed *between the chin and the os hyoides*, so as to rest upon the sides and angles of the lower jaw, the principal vessels are but slightly compressed, and the cord may be drawn tightly without any material impediment being offered to the respiratory actions. After a short time, however, a flushing of the face and a prominence of the eyes are perceived; the head becomes unusually hot; a sensation of weight is perceived in its

interior, which increases to great oppression almost amounting to insensibility; and a noise in the ears suddenly commences. When this symptom develops itself, M. Fl. remarks, it is high time to give up the experiment, as a few moments longer would be fatal. The compression may, however, be borne for as much as two minutes with impunity. There is evidently a tendency to the production of apoplectic congestion; but the vessels are not sufficiently compressed for this condition to be immediately induced. The account given of these sensations by persons who have recovered after suicidal, accidental, or experimental suspension (instances of the last being by no means unfrequent,) does not materially differ from that just quoted. A peculiar feeling of a pleasurable nature is first experienced; then imperfection of the sight, with flashings of bluish light; and these are rapidly followed by insensibility. 2. Similar consequences will follow the application of the ligature *upon the larynx*; but here the respiration is more impeded. Scarcely half a minute expires before the noise in the ears, and a sensation in the brain which it is difficult to describe, give warning that the experiment must be discontinued. It is obvious that, in this position of the cord, the vessels are no longer protected by the angles of the jaw, and will therefore be more completely compressed, so that death will result from the concurrent effect of apoplexy and asphyxia. 3. If, on the other hand, the ligature be placed *between the os hyoides and the thyroid cartilage*, or *upon the os hyoides*, and rests upon the angle of the jaw or the mastoid processes, the vessels will be almost entirely protected from compression, and the respiratory acts will alone be affected. Occlusion of the rima glottidis is produced by the depression of the epiglottis, which is forced down by the displacement of the mass of flesh that forms the root of the tongue. In this case death will be almost purely owing to asphyxia. 4. Lastly, if the cord be applied *over the trachea*, the passage of air will be completely checked, and asphyxia will soon result; the event will be less rapid if the ligature cross the cricoid cartilage. The vessels will, of course, be also compressed when the cord is thus fixed; and the signs of apoplexy will be found more or less coexistent with those of asphyxia.

It is to be recollected, in making such distinctions, that congestion of the cephalic veins is an ordinary appearance in cases of simple asphyxia; so that it might seem unfair to consider it of an apoplectic character in any instance in which there is not actual extravasation. But the value assigned to it will depend upon its amount when compared with that of other portions of the venous system, and upon the comparative state of the right and left sides of the heart. If the pulmonary arteries, the right cavities of the heart, and the great veins leading to it be all gorged with dark blood, whilst the left cavities and their vessels are flaccid, it is evident that the congestion of the brain is only a part of the general result of the cessation of the respiratory function. But if, as sometimes happens, no such general congestion is found, and the right side of the heart is not peculiarly distended, whilst the veins and sinuses of the brain are loaded, we may regard the latter as an apoplectic condition not immediately dependent upon obstructed respiration, though aggravated by it if it co-exist. And here it is necessary to remark, that although in cases of apoplexy with gradually increasing coma, asphyxia seems to be generally the proximate cause of death, there are many instances in which the fatal result occurs too rapidly for it to be thus accounted for, and in which it seems rather due to a sudden violent impression transmitted through the nerves to every part of the system, destroying the vitality of the whole at once, and putting an immediate stop to the motion of the blood. It is this kind of impression which is produced by concussion of the brain, by blows on the epigastrium, by a violent electric shock, and other similar causes which check at the same time the action of the heart and that of the capillaries, producing death by syncope. It is well known that in the lower animals the circulation will continue after the gradual removal of the whole of the brain and spinal cord: whilst sudden violent and extensive injuries of these centres, such as crushing the brain, or breaking down the spinal cord, entirely check it. This fact appears to indicate the actual propagation of an *anti-vital* influence (if

we may be allowed the term) along the nerves in cases of this nature, since the mere suspension of the function of the nervous centres cannot prove similarly fatal. In this manner only can we account for the suddenness of death in the *apoplexia fulminans*; and the same view seems applicable to several cases of death by hanging, in which the appearances are very different from those of the more common forms of apoplexy or of asphyxia, as will presently be pointed out.

The obstruction to the passage of air through the air-tubes, and the pressure upon the blood-vessels of the neck, are not the only causes of death by suspension, although it is probable that they are alone in operation when the cord has been tightened simply by the weight of the body. When greater violence has been used, it is not unfrequently found that the vertebral column has been injured, so as to compress or lacerate the spinal cord. This injury may be of several kinds, but it is generally confined to the first and second cervical vertebræ. Sometimes the odontoid process has been displaced from the atlas, with rupture or laceration of the ligaments which confine it, and has been forced against the spinal cord. In other instances it has been separated from its own vertebra; and these displacements of the atlas upon the dentatus may happen in various ways. Again the first two vertebræ have been separated from the rest of the column, by rupture of the intervertebral substance, and of the spinal ligaments. Other fractures of these vertebræ have been seen; and in all, the spinal cord was more or less injured. But even where no evident displacement is found, there is often an appearance of straining of the ligaments; and in such cases the spinal cord must have received a severe shock, which will obviously aid the other causes of death, if not itself competent to produce it.

Anatomical characters. From what has been stated as to the operation of several causes, singly or combined, in producing death by strangulation, we shall be led to expect a considerable variety in the morbid appearances afterwards found; and, indeed, it is almost only from the observation and comparison of these appearances, that our knowledge of the action of these causes is derived, since the means of observing them during life are so restricted. The description given by the older writers of the signs of death by strangulation will only apply with strictness to a limited number of cases. Indeed, it may almost be asserted, that some of the appearances mentioned are incompatible with each other, and that the description must have been drawn up by combining observations made upon several dissimilar cases. The following have been specified:—"Lividity and swelling of the face, especially of the lips, which appear distorted. The eyelids are swollen and of a bluish colour; the eyes red, projecting forwards, and sometimes forced out of the orbital cavities; the tongue enlarged, livid, and compressed between the teeth, or frequently protruded. A sanguineous froth about the lips and nostrils. A deep and acchymosed impression around the neck, indicating the course of the cord, the skin being sometimes excoriated; laceration of the muscles and ligaments in the hyoidæal region; laceration or contusion of the larynx, or of the upper part of the trachea. There are also commonly circumscribed ecchymosed patches, varying in extent, about the upper part of the trunk, and the upper and lower extremities, with a deep livid discolouration of the hands. The fingers are generally much contracted or firmly clenched. The urine, the fæces, and the seminal fluid, are sometimes involuntarily expelled at the moment of death. The body is, *cæteris paribus*, a much longer time than usual in parting with its heat." (Taylor's *Medical Jurisprudence*, vol. i. p. 165.) Some of these signs may be observed on the bodies of most persons who have come by their deaths in the mode in question; but it must be also admitted that they may all be absent. This is especially the case where the general shock to the nervous system appears to have been the proximate cause of death. They are usually most developed where death has supervened slowly, and has been due either to asphyxia produced by the direct obstruction of the windpipe, or to gradually increasing coma resulting from the accumulation of blood by pressure on the vessels of the neck. In either of these cases we find the mode of death

indicated internally by the general venous congestion, already described as indicative of asphyxia, with more or less peculiar turgidity of the vessels of the brain. It will be desirable to examine separately each of the principal external signs, with the view of determining the circumstances under which they should be respectively relied on, or their absence made a ground of hesitation.

The lividity of the face, lips, and eyelids, and the prominence and brilliancy of the eyes, are not unfrequently absent, at least for some time after death. It is somewhat remarkable that the appearance of the countenance is usually least altered in suicides; its traits being frequently those of undisturbed placidity. These signs are, on the contrary, more constantly observed on the bodies of those who have been executed; and they are still more developed where *strangulation*, as commonly understood, has been murderously performed. On an instance of this kind the graphic description given by Shakspeare was founded. (*Henry VI.* Pt. ii. Act 3. Scene 2.) It is frequently observed, however, that although the face presents no lividity, and the lips and eyelids no tumefaction, soon after the body has been cut down these appearances present themselves after an interval of some hours, especially if the ligature be allowed to remain about the neck. This was pointed out by M. Esquirol (*Arch. Gén. de Méd.* Jan. 1823,) who was the first to draw attention to the uncertainty of these appearances in cases of hanging. Although, however, their absence cannot support a negative inference, their presence may be held as a proper foundation for a positive presumption; that is, if a body be found hanging, or with a ligature tightly drawn round the neck, and these signs are present, the presumption is very strong in favour of death having taken place by strangulation. For they cannot be produced by suspension *after death* from other causes, even if this be effected immediately upon the extinction of life. This has been established by the experiments of Orfila. Sometimes lividity and tumefaction of the face will appear after an interval of some hours, even when the ligature has been removed, as was the case in some of the instances mentioned by Esquirol; more recently this has been noticed by Fleischmann (*op. cit.*, p. 436,) who attributes it to the change of position of the body, causing the blood (remaining fluid as it does) to run towards the head, which is often in the removal the most depending part. In the case of the notorious Burke, it is stated by Mr. Watson (*Treatise on Homicide*, p. 136,) that by changing the position of the body after the cord had been removed, the congestion of the vessels of the head and face could be made to appear and disappear at pleasure. As a general fact it may be stated, that the more slowly death supervenes, whether from asphyxia or from apoplectic coma, the more decidedly will these signs be presented; and that, on the contrary, they are likely to be absent whenever death results from the sudden shock sustained by the nervous system, or from complete obstruction to the entrance of air into the lungs.

The protrusion of the tongue has been considered by most writers (after Belloc) as dependent upon the position of the ligature. If this press above the os hyoides, it is stated that the tongue will be drawn backwards into the mouth; but if below the cricoid cartilage, the laryngeal apparatus will be drawn upwards, and the tongue protruded. But it must be remembered, that this protrusion of the tongue may be found in the bodies of those who have died of asphyxia from other causes, or of other diseases. Moreover, M. Devergie states (*Traité de Méd Légale*, tom. ii. p. 384,) that he has found the tongue protruded between the teeth, when the ligature has been applied even above the os hyoides; and that the same effect may be produced on the dead body; whilst he has occasionally found it within the mouth, when the ligature has been on the larynx or below it. According to Fleischmann, this change, like the former one, is mostly produced by the gradual approach of death; and is likely to be absent where death has been almost or altogether immediate. Farther inquiry is certainly needed on this point; but in the mean time it may be safely stated, that, if a body were found with the tongue protruding between the teeth, and bearing their impressions, and

other indications of strangulation were present, little hesitation need be felt in attributing death to this cause.

The next point to be considered is a very important one—the mark of the ligature upon the neck. A good deal of confusion will be found in the statements of medico-legal writers on this subject, arising principally from the vague and contradictory significations which have been attached to the term *ecchymosis*. By true *ecchymosis* is to be understood an infiltration of blood into the internal substance of the skin and sub-cutaneous cellular tissue, so that thin laminæ of these textures shall be found penetrated with it. This can only be substantiated by dissection; and from neglecting this mode of examination many observers have mistaken for *ecchymosis* the external discolouration which is often entirely independent of it. Thus we may account for the great diversity in the proportions given by different observers, of the instances in which *ecchymosis* was found on the neck after death by strangulation. Remer declares that nine-tenths of his cases presented it; whilst Klein relates fifteen cases which came under his own observation, and Esquirol twelve under like circumstances, in none of which was this lesion observed. Devergie has collected fifty-two cases in which the state of the neck was particularly observed, and in only three of these did true *ecchymosis* exist; and Dr. Casper (*loc. cit.*) states, that out of seventy-one cases, twenty-one were accompanied by true *ecchymosis*. Of the cases collected by Remer, many were probably furnished by persons who were unacquainted with the characters of true *ecchymosis*; and it is not surprising, therefore, that he should estimate the proportion so high. The discrepancy between the accounts of Klein, Esquirol, Devergie, and Casper, is however, at first sight, more striking. Still, it would probably be reconciled had we more precise information as to the mode of death in each class of cases; for it is observed that *ecchymosis* rarely or never occurs after suicidal hanging, where for the most part the body has not fallen violently upon the cord, whilst it is much more frequent on the necks of those who have been murdered or executed. The following curious case is related by Dr. Casper. A young man in a fit of drunkenness hung himself with a stout cord. He was cut down in about half an hour afterwards; and attempts were made at resuscitation. The cord had merely produced a slight superficial mark on the neck, destitute of any appearance of *ecchymosis*. Signs of returning animation began to manifest themselves; the efforts of the medical attendants were continued for several hours, but the traces of vital reaction disappeared. To the astonishment of all present, when life was about to become extinct, the mark on the neck became deeply *ecchymosed*; this was verified by an examination made the next day. This case is an illustration of the physiological fact, that to produce true *ecchymosis* there must be a continuance, for a certain time, of the vital processes to which it is due; and that, where death is very suddenly occasioned by violence of any description, all marks of that violence may be absent. This has been repeatedly observed in cases of death from concussion of the brain, blows on the epigastrium, &c. When *ecchymosed* spots are found on the neck, their correspondence with the indentation of the ligature should be carefully examined; since it not unfrequently happens that they result from violence previously inflicted, which the suspension has only been intended to conceal. Where a true *ecchymosis* is found in the line of the cord, little doubt can be entertained of the strangulation having taken place during life; since all experimental researches yet performed agree in a negative result as to the possibility of any true *ecchymosis* being produced by the application of a ligature after death, even although but a short time has elapsed. Experiments are yet wanting, however, as to the possibility of producing a true *ecchymosis* by suspension *immediately* after death; such a point is obviously very difficult of decision, and at the same time of the utmost consequence in a medico-legal view. In one instance related by Dr. Casper, the mark produced by the application of the ligature was so decided, that an individual not acquainted with the circumstances would have sup-

posed from it that the deceased had been hanged while living. But the subject had died of typhus; and although the experiment was tried an hour after death, marks of cadaveric lividity had already shown themselves; so that the tissues must have been in a state peculiarly favourable to the production of this appearance. Still, however, there was no infiltration of blood in the skin or cellular texture.

The mark which is most constantly left on the neck after death by strangulation, is a line of slight brownish-yellow discolouration, along which the skin has the dryness and hardness of parchment. This is seldom absent where a *cord* has been applied; but where strangulation has been effected by a handkerchief or other soft material, the pressure may be diffused over so large a surface that even this may not be produced. The Thugs of Hindostan, who use their turbans for this purpose, are said to accomplish their work so dexterously, as to leave no external mark whatever of the mode in which they have destroyed life. Where an indentation has been produced by the ligature, its lips have a violet tinge, especially when the ligature has not been removed; and with this the paleness, which the skin of the depression presents on first being exposed, strongly contrasts. It is not until after it has been for some little time subjected to the contact of air, that the discolouration and hardening of the skin are perceived. This character was first pointed out by M. Esquirol, who regarded it as indicative of strangulation during life; but from the experiments of M. Devergie and Dr. Casper it appears, that it is of little or no value as a single proof, since it may be produced by suspension after death. All that is required appears to be a sufficient force in the application of the ligature, and its subsequent removal. But the violet tinge of the lips of the depression cannot be so completely imitated by *post mortem* strangulation; and even though it may show itself on the upper side, it is scarcely perceptible on the lower. Whenever this is very decided, therefore, and is presented by *both* lips of the furrow, it is a tolerably positive indication of strangulation during life. We must not expect to find such a mark, however, all around the neck. It will be most decided where there have been any resisting points beneath the ligature. In case of death by suspension, we should not expect to find it at any great distance from the larynx, or os hyoides. Where strangulation has been practised, however, the circle will be more complete; and by a careful examination, we may thus be enabled to pronounce that the subject has been strangled first, and then hung—a mode in which attempts have often been made to conceal the first crime, by exciting suspicion of suicide. Sometimes when the ligature has been hard (a piece of new cord, for example,) and roughly applied, slight excoriations are produced by it, the epidermis and corpus mucosum being rubbed off. The degree of vascularity of the true skin at these spots will generally indicate whether or not the violence has been inflicted during life; and this may even be detected after the desiccation of the skin by holding it between the eye and the light. But it must be remembered that the same cause which prevents ecchymosis may prevent any vital reaction of this kind, so that a negative inference must not be drawn from its absence. Another change is produced by the forcible application of a ligature, to which also M. Esquirol was the first to direct attention. If the skin of the furrow be carefully dissected off, leaving all the cellular substance behind, a whitish silvery line will be perceived, marking its course along this tissue. This appearance seems to result from the condensation of the tissue, occasioned by the forcing of its fluid and fatty matter into the surrounding substance. If desiccation has proceeded far, the mark will not have a glistening, but a white and dry aspect. This also is principally observed on the front of the neck, and sometimes over the sterno-mastoid muscles.

A very important branch of this inquiry is that which relates to the possibility of an impression like that of a strangulating ligature being made during parturition, by the twisting of the umbilical cord round the neck of the child, and the traction to which it will be subject if not preternaturally long. Medical jurists

and accoucheurs seem pretty fully agreed as to the improbability of such an occurrence; and most authors deny its possibility. Klein, for example, states, that although he has examined a considerable number of infants who came into the world with the cord twisted round the neck, he has never detected any traces of it, either in the form of actual ecchymosis or of any impression whatever. The importance of this question to the medical jurist is evident, from the frequency of attempts to conceal the commission of infanticide by strangulation, by twisting the cord around the neck, so that death may be referred to natural causes. This contrivance may often be detected by collateral evidence, although we may admit the possibility of an impression being produced on the neck in this manner; thus, foreign matters, such as bits of straw, fine gravel, &c., have been found on the inside of the folds of the cord; or the child has been proved to have breathed freely. That an impression *may be* thus produced, however, and that the child may die from this kind of strangulation, and may still have breathed, is proved by the collection of cases recently published by M. Taufflieb. (*Annales d'Hygiène*, tom. xiv. p. 340.) In one of these the infant had lived for a quarter of an hour, and its lungs were crepitating and floated in water; but it had evidently died of apoplexy, for which the twisting of the umbilical cord sufficiently accounted. In this case the mark was a narrow red line encircling the neck, without any extravasation or depression. In another there was a livid mark, and the skin had assumed the *parchment* character, which was sensible to the touch as well as to the sight. M. Carus relates a case in which *sugillation* resulted from the same cause; but whether true ecchymosis is to be thence understood, we are unable to say. It has been supposed that the margin of the os uteri might, in a case of protracted labour, occasion a similar impression by contracting on the neck; but we are not aware that any positive example of such an occurrence has ever been produced.

Additional marks of violence about the neck, such as rupture of the muscles in the hyoideal region, fracture of the os hyoides or of the cartilages of the larynx, are of rare occurrence. When such are found, they afford a strong indication that the strangulation has *not* been suicidal, since very few instances have been recorded in which any of these have resulted from self-inflicted violence. It may not be possible to say, however, that these injuries were inflicted during life, and that they are to be relied on as proving that death was due to the suspension or strangulation which produced them. For, if inflicted *immediately* after death from other causes, the appearance they present may very much resemble that which they would assume if they had been suffered at the termination of life, so that they do not forbid the idea of the subject having been murdered first, and suspended or strangled afterwards. Another indication of death by strangulation has been pointed out by M. Amussat,—namely, rupture of the inner and middle coats of the common carotid arteries. This, however, has been only twice noticed; once by M. Amussat, and once by M. Devergie. It is not improbable that it may not be of unfrequent occurrence, escaping observation from its peculiarity; but we have no evidence that it may not be produced by post mortem strangulation. The ecchymosed patches which have been described as common on the upper part of the body in persons who have been strangled, are seldom any thing more than spots of peculiarly deep lividity, which occur after all the varieties of death by asphyxia. Where decided ecchymosis is found, we should be led to attribute it to external violence. The contraction of the fingers cannot be much relied on; as, although pretty general in death by strangulation, it is almost equally common in other kinds of violent death.

The state of the genital organs has been much attended to, as a character of strangulation. Erection of the penis not unfrequently occurs, and it is often followed by emissio seminis. It is not very easy to say in what proportion of cases this takes place. Erection may occur at the moment of suspension, and may subside afterwards, so that no traces shall be found of its having taken place. In Dr. Casper's memoir already referred to, it is stated that this change took place

at the moment of suspension in every one of the fourteen negroes who were executed together; but that in only nine were any marks of it found an hour after death. M. Devergie has recently attempted to show, that where no appearance of erection is found, there is a general congestion of the vessels of the genital organs, which does not subside for some time, and which contrasts strongly with the usual pallor of these parts after most kinds of death. (*Annales d'Hygiène*, tom. xxi. p. 174.) The membrane of the urethra he has found highly injected, especially towards the extremity of the penis. No sufficient evidence has yet been brought, however, to prove that a corresponding state is generally produced in the genital organs of the female; it has been detected in a few instances by Remer and Casper. Emission of the seminal or prostatic fluids is more frequently perceived to have taken place; but it is liable to occur from other causes, such as injuries of the spinal cord by direct violence. Casper met with this emission in nineteen out of seventy-seven cases,—not much oftener, therefore, than one in four; but others have observed it more frequently. Care must of course be taken, not to mistake it for a discharge from the urethra itself. Devergie has recently maintained (*loc. cit.*,) that some effusion of semen into the urethral canal almost constantly takes place, although it may not be ejected from it; and he calls in the aid of the microscope to detect the animalcules characteristic of this fluid. He states that, soon after an ordinary emission during life, all traces of it disappear from the urethra; but that if it be soon followed by death, an appreciable quantity will remain there. This view is obviously deserving of considerable attention; and in no case of doubt should the test be overlooked. But there are several objections to exclusive reliance upon it, some of which have been acutely pointed out by M. Orfila (*op. cit.*, p. 471,) and we can only use it in conjunction with the facts supplied by other observations. Lastly, evacuation of the fæces is a comparatively rare occurrence; Casper observed it only four times in 106 cases.

With regard to the internal appearances, little need be added to what has been already stated. They will generally be those of asphyxia, together with a peculiar degree of congestion in the veins of the head. But this may be altogether absent, or it may be the only morbid appearance, in which case we should attribute death to apoplexy alone. In some cases no morbid appearance whatever can be detected. Extravasations of blood beneath the mucous membrane of the stomach and intestines are more common in this than in other kinds of asphyxia.

From the details we have thought it right to give on this difficult subject, it will be evident that no *single* signs can be regarded as sufficiently diagnostic of death from strangulation, for us to rely upon either their presence or absence in doubtful cases. Our decision must be founded upon the balance of several; and it will be rarely that a full investigation will leave much room for doubt. We shall, however, bring such a case under review, since it will serve to prove that death by hanging *may* take place, leaving scarcely any of the signs which have been usually regarded as characteristic of it. A man aged about thirty-six or forty years, robust and plethoric, was found hanging on a tree in a forest. He had employed for the purpose of suicide a narrow leather thong, and had disposed of it in such a manner that anteriorly it pressed between the larynx and os hyoides, and then directed itself upwards and backwards. The furrow produced by it was a quarter of an inch deep in front, rather less on the left side, and almost imperceptible on the right, where there was a knot beneath the ear by which an impression was left. The furrow was somewhat rough to the touch, and its colour was a deep yellow. No ecchymosis was found in any part of its course, or in its neighbourhood. The countenance presented no appreciable change; it was calm and pale, without disfigurement. The appearance of the eyes was in all respects natural; there was no sanguineous injection; and their globes were not prominent. There was no protrusion or lividity of the tongue; the vessels of the brain, lungs, and superior extremities contained fluid blood, but they were by no means gorged; this blood preserved its fluidity for fourteen days after death;—a moderate quantity

was found in the right ventricle; the left was nearly empty. The lungs were in a state of flaccidity very remarkable; they were so sunk in the thoracic cavity, that they did not even cover the heart laterally. (Orfila, *Traité de Med. Leg.*, tom. ii. p. 409.)

The *treatment* of cases of strangulation is to be conducted on the general principles already stated, with such modifications as the peculiarity of the case may seem to require; bleeding to a small amount, especially from the jugular vein, is evidently indicated where there is much turgescence of the vessels of the head; but it should never be carried far at first, though it may be subsequently necessary to abstract a larger amount when the circulation is re-established. When the face is pale, however, and the general appearances are not those of venous congestion, such a step is highly improper; and the administration of stimulants is rather indicated. It will be seldom that any measures can be successful after the lapse of a few minutes, unless there be some peculiarity in the circumstances of the suspension. It has happened more than once that ossification of the larynx has prevented the occlusion of the air-passages, and that the position of the ligature has been such as not seriously to impede the circulation, so that recovery has taken place after a whole night's suspension.

Submersion. Although death cannot, in strictness, be said to take place by submersion, unless the whole body be covered by fluid, the distinction is of little practical importance; and the term may be conveniently applied to all those cases in which the entrance of air into the lungs is prevented by the immersion of the mouth and nostrils in water or other liquid. With our present knowledge of physiology, especially in regard to the vital importance of the function of respiration, it seems extraordinary that any difficulty should ever have been felt in accounting for the occurrence of death under such circumstances. So little, however, was the subject of asphyxia formerly understood, that the fatal termination was attributed to the injurious effect of the contact of water with the surface of the body. In order to show that an animal could live under water, provided that the continuance of its respiration were ensured, M. Gauteron made the following experiment:—Having fixed a long tube into an opening in the trachea of a dog, he forcibly retained the animal at some depth under water, keeping the end of the tube above the surface. In this situation the animal remained upwards of a quarter of an hour, respiring freely through the tubes, and at the termination of the experiment, it was found to have sustained no injury. This may almost be regarded as a useless cruelty, when it is remembered that a similar experiment has been prepared for us by Nature, who has adapted the elephant to remain for an almost indefinite time under water, by the prolongation of the air-tube through its extended proboscis. Various other hypothesis have been advanced to account for death by submersion, some of them almost equally absurd with that just mentioned. Of these it will be desirable to advert to a few, which are founded more or less upon observed facts.

Among the older writers we find death ascribed to the ingestion of water into the stomach—almost as unphilosophical a cause as it is possible to imagine. Many cases of drowning occur in which no water passes down the œsophagus; and its entrance appears to depend on certain accidental circumstances which will be explained hereafter. Even if it were constantly found, it would be ridiculous to attribute death to it; since it is well known that a much larger quantity than is ever seen in the stomach of a drowned person may be ingested without any deleterious effect.

By many physiologists, the introduction of water into the air-passages has been conceived to be the proximate cause of death. With our present knowledge, however, it must at once be evident that this can only be injurious by preventing the entrance of air into the air-cells; and that it cannot, therefore, be more prejudicial than the external obstruction. Other fluids may be more deleterious; but water, if so introduced in the healthy state, is gradually absorbed. Goodwyn injected two ounces, by small quantities into the trachea of a cat; the animal

seemed to breathe with some difficulty, but did not seriously suffer, and was at last strangled. Similar experiments were tried by Gardanne and Vernier upon dogs and rabbits; they injected four times more than is ever found in the lungs of these animals when drowned; and they found that the dyspnœa gradually passed off, and that perfect recovery took place. It is quite possible, however, that when respiration is suspended, and before absorption can take place, the introduction of any considerable quantity of water into the lungs may contribute to stagnate the pulmonary circulation; since it has been found by Dr. Southwood Smith that, if water be injected into the air-passages so as to completely fill them, it is almost impossible to force any liquid through the pulmonary artery.

Others have ascribed death by drowning to a collapsed state of the lungs, by which it is supposed that an impediment is offered to the passage of blood through them. Though it frequently happens that a large quantity of air is expelled during submersion, and that this being replaced by none, the lungs are found to contain little air after death, such is by no means invariably the case; and we cannot, therefore, attribute death to this cause. Even supposing it were constant, it would require to be proved that this collapse offers any sufficient impediment to the passage of blood, which we have no reason whatever for believing. That it aids in producing the stagnation when it does take place, may, however, be reasonably admitted; since it is known that a much-contracted state of the lungs is as unfavourable as over-distention to free circulation through them.

Congestion of the cerebral vessels, also, has been alleged by some to be the proximate cause of death by drowning. It is quite true that this state is found to exist after death in a large proportion of those who have thus perished; but it by no means follows that it is the immediate cause of the fatal result. We have already seen that it is one of the usual phenomena of asphyxia, and that it is a consequence of that stagnation of blood in the lungs which operates so injuriously on the vital functions in general; whilst, on the other hand, this congestion, supposing it to arise from some different cause, could only occasion death by itself producing asphyxia. The supposition is therefore untenable as a general explanation; although, as we shall presently see, it is applicable to particular cases.

We can have no hesitation in regarding asphyxia, occasioned by the obstruction to the admission of air into the lungs, as the principal cause of death in the greater number of instances in which it is produced by submersion. Still, as in the case of death by suspension, there are several collateral causes, the operation of which must be borne in mind, both as explaining the variations that we meet with in the *post mortem* appearances, and as having an important bearing on the medico-legal inquiries which are often founded on such occurrences. It is to Macquer that we are indebted for the first approach to a true view of this subject. He described death by drowning to the deleterious alteration which the air contained in the lungs undergoes when not renewed by the actions of respiration. That such an alteration takes place was proved by the experiments of Berger, who states that the air expelled from the lungs of a drowning animal will be found to have lost fifteen or sixteen per cent. of its oxygen, having thus acquired about the same degree of contamination as an atmosphere in which respiration is carried on until asphyxia is induced. Although Macquer was evidently right in the main, his theory stops short at the important question, how the non-renewal of the air affects the movement of the blood and the other vital functions. Having already discussed this question in full, as part of the general subject of asphyxia, we need not here return to it.

Death by submersion may be regarded as taking place in one of four modes. *First*, We shall suppose that an individual in the full possession of his intellectual faculties falls into deep water; he descends to a depth proportional to the height from which he fell, and then rises to the surface in consequence of his specific lightness, assisted by the buoyancy of the air which is entangled in his clothes. If he knows how to swim, he may keep himself there, until, his mus-

cular power being weakened, he is incapable of the exertion: and he is then similarly circumstanced with one who cannot thus sustain himself. Although, if compared in ordinary situations, the human body is, bulk for bulk, considerably lighter than water, the case is altered when it is thus immersed in the fluid. The sudden shock, affecting the whole surface, occasions a general contraction of all the parts susceptible of it, but more especially produces a diminution in the bulk of the trunk. Of this any one may satisfy himself in the cold bath. Even when unaffected by mental emotion, he will find it almost impossible to take in a full inspiration; for the contraction of the abdominal muscles prevents the descent of the diaphragm; and the effect is increased by the pressure of the circumambient fluid, so that the abdomen becomes almost flattened. There is no doubt that this alteration is increased by the influence of agitation and terror; and this is exercised principally on the first respiratory movements which take place when the individual rises to the surface. A part of the air which the lungs contained is expelled; and it commonly happens that the attempt to replace it by inspiration causes the introduction of water along with air into the trachea. The former excites the tendency to cough; and in this effort a still larger proportion of the air is expelled, and the bulk of the chest is thus diminished. In the irregular struggles which follow, the individual sometimes sinks, sometimes rises to the surface; and every time that his face meets the air an inspiratory movement is attempted, usually with the same consequences as at first, so that the air at first contained in the lungs is gradually diminished in quantity, and partly replaced by water. At the same time the fluid is generally introduced by these efforts into the stomach. During this period the usual phenomena of asphyxia are being developed. The circulation through the lungs is gradually checked, and a state of general venous congestion is induced. This will more particularly affect the internal organs in consequence of the influence of cold upon the external surface; and the functions of the brain will be speedily suspended under the combined influence of this cause and of the diminished supply of arterial blood. All movement then ceases; the asphyxia becomes complete; and the body sinks to the bottom of the water. Some bubbles of air are usually then expelled by the external pressure, which is no longer resisted by muscular effort.

Secondly, A state of syncope may supervene at the moment of immersion, by the influence of various causes,—such as the violent shock to the nervous system occasioned by the contact of cold water with the whole surface, or the sympathy of the corporeal structure with the agitation of the mind. In such cases the individual generally rises once to the surface, and then sinks without farther struggle. Some physiologists are disposed to consider this mode of death as hypothetical merely, and are not willing to appeal to it in elucidation of the remarkable facts already adverted to respecting the length of time during which submersion may be occasionally borne; but we cannot but consider their incredulity as the result of a want of fair consideration of known facts. In the first place there can be no doubt, from the accounts of various persons who have recovered, that syncope not unfrequently comes on at the moment of immersion; and the same inference may be drawn from the occasional absence of any signs of asphyxia or cerebral congestion, joined with the want of those indications of grasping movements, which we expect to find on the hands of those who have been drowned within reach of any objects that can be laid hold of. That we cannot produce it, in the same manner at least, by experiments on animals, is not to be wondered at; since they are not susceptible of the influences upon the nervous system just described. But the same condition may be induced by blows on the head; and an animal suffering from concussion is in precisely the same state, as far as its organic functions are concerned, with a human being in a state of profound syncope from mental emotion. Now it is found, that an animal in this condition may be submersed for a much longer time than one in a state of vital activity, without its ultimate recovery being prevented; and this is readily accounted for when it is remembered, that the circulating system is here primarily affected, and the func-

tions of the nervous system already almost suspended, so that the small amount of aëration afforded by the air contained in the lungs is sufficient for the maintenance of life. This may be illustrated by the case of the hibernating animal already alluded to, which may be regarded as almost in a state of syncope; its circulation being very feeble, and its respiratory movements scarcely perceptible. It may be said to *live more slowly* than when in a state of activity; and just in proportion to the slowness of its life, is its power of supporting the deprivation of air. The same may be said of the whole class of reptiles when compared with that of birds. There is no physiological difficulty, then, in accounting for the preservation of vitality by a human being after an immersion of half an hour, or even of three-quarters; and that this occasionally takes place there is evidence which we have no right to doubt. Mr. Taylor, however, in his recent excellent work on medical jurisprudence, withholds his assent, on the ground that we have no proof, in any of these cases, of the individual not having occasionally respired at the surface, during the time when he was supposed to be submersed. He has overlooked, however, the following case, which, though involving a shorter duration, is one which establishes the condition of *syncopal asphyxia* beyond a doubt; it is related by Marc (*Manuel d'Autopsie Cadavérique Médico-Légale*, p. 165,) on the authority of Plater. A woman convicted of infanticide was condemned to be drowned. This punishment was inflicted in Germany by the now obsolete Caroline Law, according to which the criminal was enclosed in a sack with a cock and a cat, and sunk to the bottom of the water. In this instance the woman, after being submerged for a quarter of an hour, was drawn up and spontaneously recovered her senses. She stated that she had become insensible at the moment of immersion. This form of death will be most common among persons of susceptible nervous system; and therefore more frequent in the female than the male sex.

Thirdly, A state of syncope may supervene under the influence of mental emotion, when the individual has been immersed for some little time, and death may thus result in part from asphyxia and in part from syncope.

Fourthly, Death may result from some primary disturbance in the functions of the brain; produced by the direct operation of external causes. Thus, a person falling into the water in a state of drunkenness, or in the midst of a violent struggle, will have already become the subject of congestion of the brain, which, when aggravated by external cold and pressure, and by the impediment soon offered to the pulmonary circulation, may be regarded as the proximate cause of death. This is still more decidedly the case when the head strikes some hard substance in its fall, in which an apoplectic effusion is the consequence; and we then find no signs of asphyxia referrible to the submersion. As already stated, however, it is most common to find marks of cerebral congestion accompanied by the appearances which ordinarily indicate asphyxia.

We shall now consider in some detail the *anatomical characters* usually regarded as characteristic of death by drowning, the circumstances under which they are respectively produced, and the degree of importance to be attached to each.

1. In cases where death has resulted from simple asphyxia, a livid tint may sometimes be observed in the face, though this is frequently pale; discolourations are more commonly found on the hands and feet, and on other parts of the body. The appearance of the surface, however, will greatly depend upon the duration of the immersion, and upon the length of time during which the body has been subsequently exposed to the air; this will be detailed subsequently as being common to all the modes of death above described. The eyes are generally half open, and the pupils dilated. The mouth and nostrils are covered with a mucous froth; the tongue pushed forward against the incisor teeth, but not usually protruding externally. A mucous froth, rarely sanguinolent, covers the lining membrane of the larynx, trachea and bronchi; the membrane itself is sometimes deepened in colour. Water is occasionally found in the air-passages. Sometimes it exists only in the

trachea and the primary divisions of the bronchi, not exceeding half a spoonful in quantity; whilst in other instances it fills the air-tubes to their ultimate ramifications. Any substances suspended in it, such as mud or vegetable matter, may afford important indications of the locality at which the submersion took place. The lungs are usually gorged with dark fluid blood, and are sometimes so distended as to meet when the anterior mediastinum is cut through. The circulating system presents the condition described as produced by asphyxia. The stomach often contains water. Sometimes a small quantity of dark or even bloody urine is found in the bladder.

2. When syncope has been the cause of death, on the other hand, extremely little alteration from its natural condition is found in any part of the body. The whole surface is pale. The trachea sometimes contains a little water, but no froth; the lungs are sometimes collapsed, and never preternaturally distended.

3. In the third class of cases above described, the signs mentioned as characteristic of the first are observable, but in a less decided form. The right cavities of the heart, and the vessels connected with them, are fuller than those on the left side; but the latter are not entirely empty. The lungs are moderately distended with blood; but little froth exists in the trachea, and little or no water. Fluid is often found to have entered the stomach. These are, perhaps, the most common appearances, it being rare to find cases in which all those first described present themselves.

4. Death from an unequivocally apoplectic condition is extremely rare in cases of drowning: it will of course be recognised by the appearances characteristic of that state: it not unfrequently happens, however, that the congestion of the cerebral vessels is greater than that which would simply result from asphyxia.

We shall now inquire into the value of the chief of these signs, considered separately, as indications of death by drowning.

The aspect of the surface depends much upon the length of time during which the body has been immersed, and upon the interval which elapses between its removal from the water and the inspection of it. If it have remained in the water only a few hours after death, and be examined soon after its removal, but little discolouration will commonly be found, unless the phenomena of asphyxia have been developed to an extraordinary degree. A body which has been immersed in water, however, undergoes very rapid decomposition when removed from it; and the longer the immersion, the more rapid the decomposition. A very few hours will thus effect such a change in the aspect of a body which has been some weeks immersed, that it would scarcely be recognised again. This change takes place the most rapidly in a high temperature; so that a body which has been withdrawn from the water, with scarcely any discolouration of the skin or tumefaction of the face, will in summer very soon appear livid and bloated, and the features extremely distorted. The discolouration takes place most rapidly in the parts most freely exposed to the contact of air; and it is not observed on cutaneous surfaces which have been in close opposition with each other, or with their coverings. The skin becomes at first of a livid brown colour, which gradually passes into a deep green. According to Orfila, the progress of this change enables us to distinguish it from that occasioned by decomposition under other circumstances. In general, the first part of the trunk which is so affected is the skin of the abdomen; but in submerged bodies, it is the integuments of the thorax. Discolouration of the surface will take place, however, without exposure to air, provided the immersion have been sufficiently protracted; but as it is not confined to bodies that have suffered death by drowning, this is not the place to enter into a description of these changes, which have been minutely detailed by M. Devergie (*Ann. d'Hygiène*, tom. ii. 5; and *Med. Lég.*, tom. ii.) whose opportunities of observation are very great. It is right to state, however, that the accuracy of his descriptions is disputed by M. Orfila. (*Ann. d'Hygiène*, tom. vi.; and *Exhumations Juridiques*, tom. ii.)

An external sign which was formerly much relied on, is the presence of exco-

riations on the fingers, and of sand or dirt under the nails. This may obviously be of great importance in a juridical investigation; but as our present view of the subject is simply pathological, we may pass over it with a slight notice. It can only occur in those cases in which there has been a long struggle for life; and its absence, therefore, is no proof that drowning has not been the cause of death in either of three out of the four modes above specified. Moreover, the local conditions of the spot where the drowning has occurred, may prevent any such marks from being formed. Where they are discovered, however, they may afford very important evidence as to the fact of submersion having been the cause of death.

The presence of mucous froth in the mouth and around its orifices, is an indication into the value of which it is right that we should carefully inquire. This froth is formed in the air-passages, and resembles a lather of soap; its appearance externally can only result from one of two causes;—either it has been formed in such quantity as to fill the bronchial tubes, the trachea, and the mouth, and then to escape from its cavity; or, having been produced to a less amount, it has been forced outwards by the extrication of gas in the lungs, which results from putrefaction. This change takes place most rapidly in summer; and hence it is far more common to find the mouth filled with froth, and the air-passages free from it, at this season than in winter, when it rarely occurs. As its formation takes place originally in the air-passages, we may regard it as occurring under the same conditions with the mucous froth in the trachea,—a sign of considerable value, although several medical jurists have denied that any weight can be attached to it. The experiments of Orfila and Piorry, confirmed by those of Mr. Taylor, have now satisfactorily established that mucous froth can only be formed in the air-passages when the animal rises frequently to the surface to respire. It appears to be produced by the agitation or admixture of the air so taken in, with the secretion from the lining of the air-passages, and probably also with a small quantity of water. If the animal is kept altogether under water until respiration have ceased, the trachea is found perfectly smooth. It must be remembered, however, that this froth may be formed in the trachea of those who die by other forms of asphyxia, especially when protracted dyspnœa has caused a great increase in the amount of fluid poured into the air-passages. It has been attributed in some instances to putrefaction; but this is evidently erroneous, since, as already stated, when gas is so disengaged in the lungs, it drives the froth upwards into the mouth. Little fallacy, then, will be found to exist practically, in regarding the presence of froth in the air-passages of a body taken out of the water as an indication that death has taken place by drowning; but, on the other hand, its absence cannot be relied on in proof of the contrary. We have seen that, in a considerable proportion of cases, it will not be formed at all; and even when it has been formed, it may disappear under the following circumstances:—1. If the body remains long under water after death, so that the fluid obtains free admission into the trachea, the froth will disappear; this, it will presently be seen, is no uncommon occurrence. 2. If the body be exposed to the air for some days after its removal from the water, the froth will then commonly disappear. 3. If the body be placed with the head in a depending position after its removal from the water and there be much fluid in the lungs, the draining away of this will wash the froth from the mouth and air-passages. These circumstances have been particularly dwelt upon by Orfila; and they must be carefully borne in mind when the sign in question is absent in a case of supposed drowning.

Connected with the appearance just discussed is another to which considerable importance has been attached in juridical inquiries—the presence of water in the air-tubes. It is strange that this occurrence should have been denied by so many observers, since it is so easily substantiated by experiment. It has been almost invariably found to take place by Orfila, when animals were submersed; and as he used coloured fluids, of which very small quantities could be detected and distinguished from the serous fluid sometimes excreted into the passages, there is no

room to doubt that some amount of the surrounding liquid enters the trachea in ordinary cases of drowning. The quantity, however, is extremely variable. It probably depends in part upon the number of forced efforts at expiration made by the animal; but it does not, according to Mr. Taylor, seem connected with the inspiratory efforts. This author states that he has found it greater in the lungs of those which had been suddenly sunk to a great depth and drowned, than in other cases. (Taylor's *Medical Jurisprudence*. p. 128.) It has been maintained by some (and amongst them, Dr. E. J. Coxe of Philadelphia,) that the water does not enter until the period of the final respiratory efforts, when the irritability of the glottis is supposed to be so far diminished that it does not resist its passage. But this has been disproved by Orfila, who performed the following experiment with a view to ascertain the truth. Having plunged two dogs under water, he secured the tracheæ by ligatures, after the submersion of a minute in one case, and of half a minute in another, the whole of the steps of the operation having been previously prepared. In both of these cases, he found liquid in the bronchial ramifications. After being so introduced, however, it may disappear under the same circumstances as those enumerated in the last paragraph. Still it would be sufficiently easy to make allowance for these, so as to render this sign almost pathognomic, were it not that it may be imitated by the spontaneous entrance of water into the air-passages after death, when the body has remained long immersed. The possibility of this has been denied by many authors, who supposed that the valvular action of the epiglottis would be sufficient to prevent it. Experiment has fully proved it, however, not only in the case of drowned bodies, but where death has taken place from other causes, and the body has been subsequently placed in water. Orfila and Piorry found that the quantity thus admitted depended upon the position of the dead body. If it were retained under water with the head erect, the liquid penetrated freely to the ultimate ramifications of the bronchi; but it entered less freely when the body was in a horizontal position, and probably none would enter if the head were entirely depending. It is evident, then, that little importance can be attached to this sign when taken singly, though it may be useful if viewed in connexion with others. The correspondence in character between the fluid in the lungs and that of the spot where submersion is supposed to have first taken place, and its difference from that in which it is found, may, in some particular cases, afford important evidence.

Another sign of corresponding nature, on which, perhaps, somewhat more reliance can be placed, is the presence of water in the stomach. Here, again, a remarkable discrepancy has existed in the opinions of different writers; some maintaining that it never enters during the act of drowning, and others, that it cannot penetrate after death. The truth, as on most disputed questions, appears to lie between the two extremes. The experiments of Goodwyn, Orfila, Taylor, and others, have fully proved that a quantity may be swallowed during the struggles of a drowning animal; and Mr. Taylor has shown that the amount is usually the greatest when life is prolonged by occasional respiration at the surface, whilst it is generally absent altogether when the animal has been kept beneath the fluid from the first. We must not, therefore, rely upon the fact of no water being found in the stomach, as disproving the supposition of death having been produced by drowning. It will probably enter but in small quantity, or not at all, in the three latter classes of instances formerly enumerated; and even when it has been introduced, it may disappear by the effect of position during removal, or by transudation through the body, if it be long exposed to the air, especially when much decomposed. On the other hand, its presence must not be relied on as a proof that drowning has taken place, since there is no doubt that water may enter the stomach of a body which has been submerged after death. It is true that the parietes of the œsophagus are usually so closely applied to each other, that water cannot enter without difficulty. The circumstances which seem to favour its admission, are advanced putrefaction, and the subjection of the

body to considerable pressure whilst under water. To the latter condition attention has been particularly directed by Mr. Taylor, who found that if an animal be sunk to a considerable depth, the stomach becomes distended with water, even though it be not allowed to respire; and as no deglutition can take place under such circumstances, it is evident that the water must have been forced in by its own columnar pressure, and that the same cause would operate still more effectually on a dead body, where no resistance is offered by the will. It is evident, then, that great caution must be used in drawing inferences from this sign when present; but it is, perhaps, on the whole, the most valuable of all those which may be denominated the *accidental* signs of death by drowning, as it can only be produced after death under very peculiar conditions.

The alteration in the character of the urine is a phenomenon of rare occurrence, and no decided inferences can be drawn either from it or from the state of the bladder. To this last source Piorry was disposed to look, from observing that dogs usually empty that sac at the moment of violent death, and that it seems to be refilled by absorption from without, previously to the supervention of cadaveric rigidity; this, however, is not the case in man.

Little reliance can be placed upon the fluidity or coagulation of the blood, for very obvious reasons. The fluid state, supposing it to exist, may result from many causes besides drowning; and coagulation certainly takes place in the blood of a considerable proportion of drowned persons, being more common in the cavities than in the vessels.

With regard to the general value of these signs, therefore, in the determination of a case of suspected drowning, the same must be said as in regard to death by hanging—that our inferences must be founded upon the presence or absence of several conjointly, and not upon any single one. As a useful illustration of the preceding statements, we shall subjoin the summary given by Dr. Ogston (*Edin. Med. and Surg. Journ.*, vol. xlvii.) of the appearances presented in *seventeen* cases of drowning, mostly accidental, which occurred at Aberdeen. The only phenomena which were all but universal in these cases, were the dilated pupils, clenched jaws, and semi-contracted fingers. This state of the pupil was common to all the cases. In one only was the mouth open; in the rest it was firmly fixed both before and after the occurrence of rigidity in other parts. In every instance but one, the position of the fingers indicated the convulsive closure of the hands during the last struggle. The peculiar position of the tongue was almost invariably noticed, its tip being found in contact with the incisor teeth; in two cases only was it included between the closed jaws. In six of the cases, seen within six and a half hours after death, the surface was pale when first examined, and the countenance presented an appearance of extreme placidity; but discolouration and turgescence of the face speedily took place, especially when the weather was warm. The face was almost invariably reddened when the immersion had continued eight hours in warm weather; and swelling appeared soon afterwards. In three cases the *cutis anserina* was observed; two of these occurred in winter. In no instance were abrasions seen on the fingers, or dirt under the nails; this may be in part due to the local circumstances. In seven cases froth was found about the lips or nostrils. Out of the whole number only *seven* were examined internally. Of these, three presented the mucous froth in the trachea; in two, nearly an ounce of water was found in the trachea; and in two others, a considerable quantity escaped when artificial respiration was being practised. In five out of the seven cases examined, water was found in the stomach; and in several others its presence was detected by pressing the abdomen or turning over the body. In five of these seven cases, the blood was found partially coagulated in the heart, though fluid in the vessels. Besides the usual appearances in the thoracic portion of the circulating apparatus, a good deal of venous congestion was found in the head and abdomen in most of the cases examined.

Treatment. Little need be added, under this head, to what has already been stated in regard to the treatment of asphyxia in general. The point which will require attention in the resuscitation of drowned persons, is the advantageous application of heat. Owing to the conducting power of water, a body which has undergone asphyxia by submersion will have lost much more heat in the same time than one which has been hung or strangled. Although the warm bath would appear the most advantageous means of restoring this, it is objectionable in the present case, since it prevents the due influence of the air upon the skin, which is important in two ways;—by promoting the movement of blood in the cutaneous vessels through its direct aerating powers, and by serving as an excitor through the nervous system, to the inspiratory actions. We fully agree then with Dr. Kay, in thinking that, in the treatment of asphyxia by submersion, warm dry air is the best medium to which the body can be exposed. Hot vessels of water, bricks, &c. may be applied to the spine and to the extremities, but not to the abdomen. Friction with warm flannels may be advantageously practised on the trunk; but nothing should interfere with the free contact of air to a large portion of the surface. Bleeding should be employed with great caution; but where the habit is plethoric, and the veins of the neck are turgid, they may be advantageously unloaded. In default of any other means of practising artificial respiration, the bandage of Leroy, or some substitute for it, may be employed. This is simply a large eighteen-tail bandage, formed by tearing a piece of linen into strips about three inches broad, but connected together by an untorn portion at the centre of each. This untorn portion being laid upon the spine, and the strips being crossed over the thorax, compression may be very advantageously applied, so as to produce a partial expulsion of the contents of the lungs, which will be replaced by the elasticity of the parietes when the compression is renewed. This alternate pressure and relaxation should be kept up about twenty-five times in the minute; and if no large piece of cloth be at hand, it may be effected almost as well by a few handkerchiefs applied in a similar manner.

The great principle to be kept in view in the treatment of cases of drowning is that the attempts at resuscitation should not be intermitted for several hours, nor even then unless there appear no chance of success. Many have been restored contrary to all expectation, when the treatment was continued simply in conformity with this principle. The patient should be watched for some time after his apparent recovery, as dangerous reaction sometimes comes on.

There is nothing in the characters or treatment of asphyxia by *suffocation*, or more properly *smothering*, that requires peculiar notice here; nor in those of asphyxia produced by simply *irrespirable gases*. As formerly stated, death from carbonic acid and other *noxious* gases more properly falls under the head **POISONING**.

DISEASES OF THE ORGANS OF CIRCULATION.

DISEASES OF THE HEART.

Preliminary observations.—Anatomy of the heart—its site.—Relation of the lungs to the heart.—Structure.—Weight and measurement.—Motions.—Natural sounds.—Morbid sounds.—Disordered motions.—Arterial and venous pulse.—General observations on diseases of the heart.—Importance of accurate discrimination.—Means of diagnosis by local or physical signs and by general symptoms.—Causes.—Prognosis.—General view of their treatment.

Of the diseases to which the human frame is liable, few have of late years attracted more attention, or been investigated with greater ingenuity and perseverance, or with more successful results, than affections of the heart. It was impossible that a class of disorders characterized by symptoms of so prominent and distressing a nature should have altogether escaped the notice of the ancients; and accordingly traces of an acquaintance with them are to be met with in the writings of the Greek and Arabian schools, but generally so faint and indeterminate, in consequence of the prevailing neglect of pathological anatomy, that they are now little referred to except as matter of curiosity.

The foundation of the more accurate notions which we at present possess on this subject was laid by Harvey by his discovery of the circulation; and for the first solid and conspicuous portions of the superstructure we are indebted more particularly to Lancisi, and the second Albertini and Valsalva, and their distinguished pupil Morgagni, and to Senac. Corvisart's graphic treatise on diseases of the heart, of which the first edition appeared in 1806, formed a new era in respect to the knowledge of these affections, and gave a fresh impulse to their investigation in various parts of Europe, as was speedily evinced by the successive appearance of the valuable works of Burns and Testa, Kreysig and Bertin. By the revival of Avenbrugger's method of percussion, and by Laennec's invaluable discovery of the stethoscope, new and unprecedented facilities were furnished for their study; and that these have not been neglected we have ample evidence in the pages of the great pathologist last named, as well as in the contributions of a host of able successors in the same path, more especially in this country and in France.

ANATOMY OF THE HEART.

Before entering in detail upon the particular diseases to which the heart is liable, it may be useful briefly to recall to the reader's memory a few points of practical importance in respect to the site and structure of the organ, its normal size and weight, its component tissues, its motions, and the sounds by which they are accompanied.

Site of the Heart.

An accurate acquaintance with the position of the heart within the chest in its natural condition, the space which it ordinarily occupies, and its relation to the lungs and solid parietes of the thorax, as well as to the diaphragm, is indispensable to enable us to detect the existence of various degrees of displacement and enlargement of the organ, as well as the effusion of fluid which occasionally takes place into the sac, which in the healthy state closely embraces it. The heart, which is of an irregular conical form, flattened on the under surface, is situated in the anterior mediastinum, towards the left side of the chest, behind the lower half of the sternum, the third intercostal space, and the cartilages of the fourth and fifth and sixth ribs.* Its base is directed upwards, backwards, and to the right side, looking towards the fifth, sixth, and seventh dorsal vertebræ, the œsophagus and descending aorta intervening; and its point consequently downwards, forwards, and to the left, answering, in the erect posture, and when the chest is in a medium state of distention, and the heart in the act of systole, to the fifth intercostal space, that is, in a middle-sized individual, to a point about two inches below, and one to the inside of the nipple; or two and a half from the outside of the base of the xiphoid cartilage. It is protected, and to a certain degree confined to its position by the sero-fibrous sac of the pericardium, which is strongly attached below the diaphragm around its tendinous centre, and made fast superiorly to the great vessels some way above their origin, or about as high as the second rib; whilst they are in their turn fixed, in a manner, by their branches, and by connecting cellular membrane to the upper part of the thorax and root of the neck.

The pericardium and heart are covered laterally by the lungs, and also anteriorly, with the exception of a lozenge-shaped space of somewhat less than two inches across, answering to nearly the whole front of the right ventricle, and to the most anterior portion of the appendix of the corresponding auricle, together with merely the apex and external edge of the left ventricle. These exposed portions as well as the root of the pulmonary artery and the ascending aorta, after it has emerged from behind it, are separated from the parietes of the chest only by the pericardium and loose cellular tissue. About one-third of the heart, consisting principally of the right auricle and the upper and right side of the base of the corresponding ventricle, lies behind the sternum. The orifice of the pulmonary artery and its valves, and consequently those of the aorta likewise, which lie posteriorly, but nearly in the same line, are placed immediately behind the upper edge of the fourth sterno-costal articulation of the left side.†

The auriculo-ventricular orifices of the two sides of the heart lie to the right and left respectively of the point just indicated, that of the right side being at a lower level by several lines. Where they approach each other most nearly, being scarcely the third of an inch apart, they would be actually covered by the root of the pulmonary artery, but that they are placed a little lower or nearer the apex of the heart. Still a moderate-sized stethoscope, applied over the origin of the pulmonary artery and its valves, will cover also the aortic orifice and its valves, as well as a very considerable portion, nearly a half of each of the auriculo-ventricular openings, a fact to which we shall afterwards have occasion to recur, on account of its practical bearing in the diagnosis of the different species of valvular disease.

The bulging portion of the pulmonary artery, just below the division into its two trunks, has been singled out by Dr. Hope as a fixed point of easy determina-

* As in fat persons there is often much difficulty in counting the ribs, we may recall to the reader's memory that the nipple generally answers to the fourth rib.—AUTHOR.

† If examined from the back, they are opposite to a point just above the left side of the fifth dorsal vertebra.—AUTHOR.

tion; being seated, as he states, between the second and third ribs of the left side, close to the sternum. The aorta inclines "slightly to the right as it ascends, coming in contact with the sternum where it emerges from beneath the pulmonary artery, following, or perhaps slightly exceeding, the mesial line till it forms its arch; the pulmonary artery, which is from the first in contact with the sternum, inclining more considerably to the left until it arrives at the interspace between the second and third rib."

A sharp instrument passed through the upper part of the sternum in the median line and on a level with the first intercostal space, would glance along the upper part of the arch of the aorta, as it is passing from the right side of the sternum to the left side of the third dorsal vertebra.

The antero-superior surface of the heart, which, as we have seen, is formed chiefly by the right ventricle, is convex; whilst the postero-inferior surface, answering to the left ventricle, is flat, and lies upon the tendinous portion of the diaphragm, the motions of which it must necessarily follow. These, however, are obviously very limited, in consequence of the strong unyielding texture of the pericardium, and of the firm manner in which it is attached, as already mentioned, both above and below. Yet the heart is certainly carried a little downwards and backwards in inspiration, its apparent change of place being still farther increased by the sternum and anterior portion of the ribs simultaneously ascending; whilst in expiration, on the contrary, it rises again and moves a little forwards, the ribs at the same moment descending, and thus conspiring to magnify the apparent elevation of the heart. Hence a deep inspiration, as is remarked by Dr. Williams in his valuable lectures, makes the apex beat below the sixth rib. "The impulse is then, however, scarcely perceptible, because the chest expands as the ribs rise, leaving the heart and drawing the porous lung in front of it. A forced expiration, on the other hand, depresses the ribs, and transfers the strongest pulsation to be between the fourth and fifth ribs, and by bringing down the walls into contact with more of the heart, makes its impulse perceptible over an extended space, as high as the third rib, and on the lower half of the sternum;" and a knowledge of these circumstances, he adds, enables us to test the freedom of the heart and pericardium, and the anterior portion of the lungs, from adhesions. Where the chest is narrow or deformed, or contracted from the chronic consequences of pleurisy, the impulse of the heart may be perceptible over a much greater surface than natural. "So, also, circumstances displacing the heart, such as tumours and effusions of liquid or air into the pleura, may greatly change the character and degree of the impulse, diminishing or increasing it, according to whether the displacement of the organ is from or towards the walls of the chest. Abdominal tumours, and even a distended stomach, may have to a certain degree the same effect." Changes in the pulmonary tissue are very influential in the same way; emphysema may intercept or circumscribe the impulse, whilst consolidation will propagate it over a larger space.

That the position of the heart is affected in a very sensible degree by gravitation, and consequently by posture, any one may satisfy himself by applying his hand over the spot where the beat of the heart is usually perceptible, and then turning the body successively on the back, the sides, and the face; when the organ will be felt to incline towards the most dependent part, retreating in the supine posture, and coming forward in the prone. The pulsation will be felt most strongly and over the largest surface when lying on the face and slightly turned towards the left; or, if we be sitting or standing, by inclining the body forwards and to the same side, and at the same moment making a forcible expiration. The change of the place of pulsation thus effected is, however, too inconsiderable to be confounded by any competent observer with the derangements of this kind dependent, on original malposition of the organ, or on disease.

Relation of the Lungs to the Heart.

The extent of the uncovered portion of the heart may be ascertained, even during life, by the dull sound elicited by percussion from the corresponding portion of the chest. This in healthy well-formed individuals rarely exceeds, as we have seen, an area of about two inches in diameter, reaching from the point where the beat of the heart is felt to the left side of the lower half of the sternum. And hence arises a valuable source of diagnosis in disease; for in cases of effusion into the pericardium, or of organic enlargement of the heart, and perhaps also of its temporary passive distention by the excessive accumulation of blood within its cavities, the extent of this dulness will ordinarily undergo a proportional increase. Yet this, though a very valuable sign, is not to be considered, when alone, as affording unquestionable evidence of cardiac affection; for the interposition of a portion of hepatized lung, or of a tumour, between the pericardium and the front of the chest, or a partial pleuritic effusion confined by false membranes, or even a great enlargement of the left lobe of the liver, would give rise to the same physical phenomenon. Nor, on the other hand, is the absence of such preternatural dulness decisive as to the non-existence of the cardiac lesions alluded to above; as an emphysematous state of the lung, or the presence of pneumothorax, or an usual degree of gaseous distention of the stomach might, in a great measure, mask an enlargement of the heart or a pericardial effusion.* Even in the natural condition, the dulness ceases on lying back, or taking a very full inspiration; and this is another way, as remarked by the author last quoted, of testing the free and unattached condition of the heart and lungs,—for if the dulness still persists over a considerable extent, even under those conditions, we must conclude either that the heart or lungs are adherent, or that the former organ, from its great bulk, or the pericardium, from its extreme distention, cannot recede. In the last case the impulse will be diminished; in the former it will be increased. We must not expect, even in the natural state, in any posture, to find the region of dulness very sharply defined. It is, in truth, shadowed off in proportion to the thickness of the intervening lung, which increases gradually as we recede from the uncovered part of the heart. But the site even of the remoter portion of this latter organ becomes revealed, or proportionably augmenting the force of percussion; for it is only by a pretty sharp stroke that the dulness indicative of a deep-seated solid can be detected. By the same mode of proceeding we may sometimes recognise an enlarged heart, even though little of it may be in contact with the front of the chest; and get the better also of the obscurity which, as we have stated, emphysema is liable to create. When there is great enlargement of the heart, very strong mediate percussion may detect deficient resonance, even in the left lateral and posterior portions of the chest. (Williams.) So likewise M. Piorry, who states that the heart in its natural condition is in contact with the parietes of the chest over a space of near two inches in diameter, wherein the dull sound on percussion is very obvious; but that the organ extends from an inch and a half to two inches farther over to the left side, under cover of the lung, where likewise its existence may be detected by forcible mediate percussion. The vertical extent of dulness is slightly less than the transverse. The distance of the heart below the top of the sternum is generally from three to three and a half inches, unless when enlargement of the organ exists, or the diaphragm is thrust upward by disease, when it may be reduced to one-half less. Immediately after death, the extent of dulness is somewhat less than during life, from the diminished turgor of the walls of the organ.

* "The chicken-breasted conformation of the chest, especially when connected with spinal gibbosity," is pointed out by Dr. Hope as another cause that may prevent the development of dulness on percussion."—AUTHOR.

Structure of the Heart.

It is not our intention to enter at any great length into the natural structure of the heart; a few circumstances, however, which have a bearing on its pathological anatomy may here be mentioned. The cavity of the right ventricle in the adult is broader but less elongated than that of the left, in consequence of which latter circumstance the apex of the heart is formed exclusively by the left ventricle; the distinction between them, or the direction of the septum, is marked externally by a furrow, in which lies the descending branch of the coronary artery and vein. In the fœtus, however, and for some time after birth, the left ventricle is comparatively shorter, and the point of the organ is consequently made up by two sides almost equally. The tortuous disposition of the muscular fibres of the heart, which baffled the earlier anatomists, has been more successively investigated in later days by Wolff, Duncan, and Gerdy. The parietes of the left ventricle, according to the last-named anatomist, contain six muscular layers, those of the right only three. The fibres of the external layers run obliquely from above downwards, from before backwards, and from right to left; the middle layers take in all respects the opposite directions; and the deep-seated ones, which, by their union, form the fleshy columns projecting into the interior of the cavities, are, for the most part, longitudinal. The most superficial layers, passing along the apex, occupy the entire circumference of the ventricles, whilst the others diminish in length and breadth in proportion as they follow a deeper course; and hence it is that the ventricles are so much thicker at the base than at the point of the heart. All the fibres, whatever may be their disposition in other respects, turn upon themselves in such a manner, at their middle point, as to form a species of loop, the convexity of which look towards the apex of the organ; and the more superficial the fibres are at one extremity, the deeper seated do they become at the other: thus the most external fibres, for example, become, before their termination, the most internal, in consequence at once of their having been reflected in the manner just described, and also of having traversed the thickness of the ventricle. The extremities of these loops are invariably inserted at the base of the heart around the circumference of the auricular and arterial orifices of the ventricles, either immediately or in a smaller number of instances, by the intervention of the tendons attached to the auriculo-ventricular valves (*chordæ tendineæ*.) The auricles are, according to the same authority, composed of two muscular layers; the one external, the other internal. In the right auricle, the muscular tissue being less abundant than in the left, leaves occasional intervals between its fibres, where the internal and external membranes of the heart are in almost immediate contact; and this proximity helps to explain the frequent co-existence of inflammation of the internal lining of the heart with that of the pericardium.

The subject of the structure of the heart has still more recently been investigated by Dr. Carlyle, who has arrived at conclusions very similar to those of M. Gerdy; whilst M. Filhos, on the other hand, still calls in question the continuity of the external with the deeper-seated fibres; it appearing to him that, after turning from right to left, and from above downwards, in a spiral direction, near the apex of the ventricle, they terminate in a well-marked *raphé*, from which the internal fibres likewise take their origin. It appears to us, however, from the careful examination of the heart of an ox, the fibres of which had been rendered easily separable by long-continued boiling, that the former view is a true one.

The columnæ carneæ are more numerous in the right ventricle than in the left; but those which act on the valves of the former are smaller than the corresponding ones of the opposite side. The fibrous or albuginous nature of the tissue of which the *chordæ tendineæ* are formed, and which enters also into the composition of the whitish zones at the base of the valves, surrounding and strengthening the orifices, as well as within the serous duplicature of the valves, enables us to understand why those parts so frequently afford examples of cartilaginous and

osseous degeneration. The knowledge of the existence of such a tissue in this situation, together with that of the sero-fibrous structure of the envelope of the heart, should prepare us to expect this organ to be a frequent seat of rheumatic inflammation.

The endocardium, or fine semi-transparent polished membrane lining the interior of the cavities, resembles in nature and tenuity the more delicate of the serous membranes; and like the inner coat of the vessels, it readily receives, by imbibition, under certain conditions, the colouring matter of the blood, whence generally originate the reddish stains so often observed within the heart. It is neglected inflammation of this membrane, according to M. Bouillaud, an author to whom we shall have occasion very often to refer, that a great majority of the organic diseases of the heart have their source, and especially in that portion of it which lines the valves and orifices, where it is naturally thicker than in other situations, and necessarily exposed to a greater degree of stress and friction. Chronic inflammation, it is supposed, may lead not merely to morbid thickening and inequality of this structure, but also to the effusion of coagulable lymph on its surface, as well as to hypertrophy and degeneration of its subjacent cellular and fibrous tissues, inducing immediately diseases of the valves and orifices, and secondarily, thickening of the walls of the heart, and enlargement of its cavities. Though in its natural condition it can be detached only in minute shreds, yet in certain states of disease its adhesion to the subjacent tissues becomes so much diminished that large patches of it may be raised entire. Around the contours of the orifices or base of the valves, as well as in the situation previously indicated, the inner and outer linings of the heart come into very close approximation, only a very thin layer of connecting cellular membrane intervening; so that here, also, the transmission of inflammation between the two surfaces is peculiarly favoured.

Weight and Measurement of the Heart.

It would obviously be very desirable towards assisting us in the appreciation of certain cases of enlargement and diminution of the heart, to possess some definite standard of its normal magnitude. This, however, taken in an absolute or mathematical sense, is evidently unattainable, for the size of the heart, like that of all the other organs, is susceptible of various shades of difference, all of which may yet be within the natural limit, or the limit of health. All, then, that we can rationally attempt is, either to establish a rough comparison between its size and that of some other organ appertaining to the individual examined; or else to obtain an approximate or average value for it, in figures, deduced from a large number of particular cases. Of these two expedients Laennec contented himself with the former, laying it down as a general rule that the healthy heart was ordinarily about equal in size to the fist of the subject to which it belonged, a rude standard of comparison, of which the chief recommendation is the facility of its application. The walls of the left ventricle, he adds, are about double the thickness of the right, and sufficiently firm to prevent their falling together and obliterating the cavity on being cut across; the right ventricle is a little larger, and from the thinness of its walls should in the natural condition collapse on incision. Since the time of Laennec, however, in consequence of the vogue of the numerical method in other branches of pathology, several French, German, and English physicians have endeavoured to solve the physiological problem alluded to by the system of averages expressed in numbers, setting forth thus the medium weight, and measurements of the heart. Thus the average weight of the heart of the adult in its normal condition, and after being emptied of its blood, and having the great vessels cut away, was estimated by M. Cruveilhier at 6 or 7 ounces French;* by M. Lobstein, and by Meckel so high as 9 or 10 ounces, the latter adding that its

* The French ounce is to the English ounce avoirdupois about as 15 to 14.—AUTHOR.

weight is to that of the whole body about as 1 to 200;* whilst by M. Bouillaud and Dr. Clendinning (whose results, having apparently been arrived at from a much larger number of observations, made with peculiar accuracy, are especially worthy of confidence) it is stated at between 8 and 9 ounces for the adult male; the average weight of the female heart according to Dr. Clendinning, being about an ounce less. A heart in a state of hypertrophy will weigh from 11 to 24 ounces, or even more. Laennec mentions one of two pounds and a half, and Dr. Mason Good speaks of some still more enormous specimens; but as they do not expressly state whether or no the blood and coagula had been removed from the interior, we cannot rely on their estimate. A heart in a state of atrophy, on the other hand, has been found to weigh only from five to six or seven ounces; so that the balance, when taken in connexion with previous symptoms, obviously furnishes us with a very satisfactory test of changes in the heart's mass. We cannot, however, with any safety estimate the quantity of matter which it contains by the eye alone, or even by measurement; for as the experiments of M. Jules Pelletan, have shown, there is a very considerable difference in hearts in respect to specific gravity.

The recent researches of M. Bizot, which were carried on with so much seeming accuracy, and on so extensive a scale as to entitle them to a peculiar degree of credit, have led to the establishment of some very unexpected results, which stand in direct opposition to the previous surmises of the highest authorities in medicine. Thus, he has found that the size of the heart continues to increase regularly in proportion with advancing age; and that this depends partly on the gradually augmenting capacity of both ventricles, and partly on the steadily increasing thickness of the walls of that of the left side especially, those of the right ventricle remaining almost stationary. In respect to the influence of stature, he has arrived at a startling conclusion, which, though his data are numerous, stands perhaps in need of additional confirmation based on a still larger induction of particulars—namely, that in tall persons the mean dimensions of the heart are actually less than in middle-sized individuals, and that this holds especially in respect to its breadth. The width between the shoulders he has found to afford a much better criterion of the probable size of the heart than the height. It is right to state that Dr. Clendinning's investigations have led him to acquiesce entirely in M. Bizot's assertions in respect to the effects of advanced age and height on the size of the heart. Thus, whilst in individuals above sixty all the other organs have evidently suffered a loss of weight, he finds the heart to be increased, on an average, by at least one-twelfth. Dr. Clendinning is however at variance with Bizot, no less than with Louis, in respect to the state of the heart in phthisis, in which disease he has, like Andral, generally found it in a very appreciable degree enlarged; the wasting characteristic of the disease falling rather on the external parts, or organs of locomotion, than on the internal viscera, as he has proved indisputably by the use of the balance.

The mean length of the heart, measured from the base to the apex of the left ventricle, was found by M. Bouillaud slightly to exceed $3\frac{1}{2}$ inches;† the breadth at the base was a fraction more than this; the thickness of the base, measured from before backwards, was about 2 inches; the circumference at the same part almost 9 inches; the thickness of the septum measured, in the single instance in which it was examined, 11 lines, but this, we think, is quite above the usual average. Meckel states it at from four lines to half an inch; the latter measurement, as it appears to us, being nearest the truth. The mean thickness of the left ventricle, measured near the base, generally the thickest part, was nearly 7 lines, that of the right about $2\frac{1}{2}$ lines; so that Laennec would appear to have somewhat

* In infancy the heart, and more especially its cavities, are *relatively* much larger than in adult age.—AUTHOR.

† Meckel states the whole length of the heart at five inches and a half, of which four for the ventricle and one and a half for the auricle.—AUTHOR.

undervalued the difference of thickness of the two ventricles, in stating the one to be only a little more than double as thick as the other; the real proportion being more nearly as three to one. In infancy, however, no such great disproportion exists; and in the fœtus their walls are nearly of equal thickness. The mean thickness of the left auricle is about $1\frac{1}{2}$ line, that of the right about 1 line.

The capacity of the right cavities of the heart has been correctly stated by most anatomists, as somewhat exceeding that of the left. The difference, however, is, as we should expect, not very considerable; and even less than from the ordinary state of distention of the right side of the organ after death it would at first sight appear to be. Bizot estimates the difference somewhat higher than Laennec or even than Bouillaud. The cavity of the left ventricle in its natural condition is about equal in capacity to a moderate-sized hen egg.

The mean circumference of the left auriculo-ventricular orifice may be stated at about $3\frac{1}{2}$ inches, that of the aortic orifice at about $2\frac{1}{2}$. The corresponding orifices of the right side are usually, as might be anticipated from what has been said in the last paragraph with respect to the comparative size of their cavities, slightly larger (Bizot says, on an average, by about nine lines;) this, however, if Bouillaud be correct, is not universally the case.

The depth of the mitral and tricuspid valves is from 8 to 9 lines; that of the pulmonary and aortic about $5\frac{1}{2}$ or 6; those of the right side, in each instance ordinarily exceeding by a fraction those of the left, though somewhat inferior to them in strength. How great a deviation from the above measurements may be induced by disease from the following facts. The circumference of the heart in a state of hypertrophy has been found occasionally to measure 12 inches; the ventricles in length $5\frac{1}{4}$ inches, or even more; the wall of the left ventricle from 7 lines in thickness to considerably upwards of an inch; that of the right from 3 lines to $4\frac{1}{2}$ and upwards. The capacity of these cavities in cases of dilatation, with or without hypertrophy, is occasionally doubled. The circumference of the auriculo-ventricular orifice of the left side was increased in one of M. Bouillaud's cases of hypertrophy of the ventricles to $4\frac{1}{4}$ inches, whilst in another it was contracted, in consequence of diseased valves, to 2 inches. The circumference of the aortic opening was enlarged in one instance to about $3\frac{1}{2}$ inches, and diminished in another to less than 1 inch, and still more extreme cases, than those are occasionally met with.

In respect to all the above measurements, weights, and proportions, it must never be forgotten, when we go about to apply them practically as standards of comparison, that they are mere averages, deduced, moreover, from but a limited number of cases. Consequently every slight deviation from them, whether in excess or deficiency, is not at once, and without farther consideration of the circumstances of the case, the age, sex, make, and muscular development of the individual, to be set down as evidence of disease of the heart. Thus, for example, the heart of a man built on a very broad scale may weigh some ten or eleven ounces, whilst that of a small and delicate female on the contrary, may not exceed six or seven ounces, and yet there shall not be disease of the organ in either case.

Again, in estimating the thickness of the walls of the heart, we must take simultaneously into consideration the apparent size of the cavities which they bound, the previous symptoms, and the peculiar mode of death; for when from a considerable reduction of the mass of circulating fluids, by profuse hæmorrhages, extreme evacuations, or a long-continued low scale of diet, the muscular parietes, in order to accommodate themselves to their diminished contents, have become notably contracted, a proportional thickening will necessarily exist. From this cause, the walls of a heart actually in a state of atrophy have sometimes been found, as M. Bouillaud remarks, apparently even thicker than natural. If these modifying circumstances be kept in mind, the above standard can scarcely fail of being serviceable, at least to the young pathologist, by giving a definite direction to his anatomical researches, and furnishing him with a useful basis of com-

parison, till his eye has been in some degree formed by the frequent inspection of morbid parts.*

* Of several measurements of the heart and attempts to appreciate its relations to different points of the chest, made with the assistance of a very accurate observer, Dr. J. Macdonnell of the Richmond Hospital, Dublin, some already have been stated, and a few others may be sub-joined here. The principal object was to determine the relation of the orifices, amongst themselves and to the surrounding walls of the thorax. Similar investigations have been made by Dr. Hope and others, with nearly, but not precisely, the same results.

The points, the establishment of which was especially aimed at, was, the impossibility of discriminating disease of one orifice from that of another, merely by applying the stethoscope over the situation where the morbid sounds are produced, seeing that in no instance are the most adjacent points of any two of the orifices much above an inch apart; and in respect to most of them not above the third of that distance.

The aortic and left auriculo-ventricular orifices are nearly in contact at their most adjacent points; the interval between the former and the orifice of the pulmonary artery, which stands highest, is likewise very inconsiderable, not exceeding a few lines. The distance between the nearest parts of the pulmonary artery and of the right auriculo-ventricular orifice, though greater than in the other instances, scarcely exceeds an inch. The bases of the *auriculo-ventricular* valves are situated a very little lower or nearer the apex of the heart than the *aortic* valves, viz. about a quarter of an inch on the left side, and half an inch on the right. At least one-third part of the circumference of each of the auriculo-ventricular orifices and their valves, thus lie close under the semi-lunar valves of the aorta and pulmonary artery; so that a stethoscope placed over the latter would necessarily, as already stated, cover a considerable portion of all the four orifices, even if the heart hung vertically in the chest, and obviously a still greater part of their circumference in the actual position of the organ, with its axis forming nearly half a right angle with the parietes of the thorax, and deviating so much to the left side anteriorly, where the stethoscopic examination is chiefly made.

A horizontal line drawn through the under edge of the sterno-costal articulations of the fourth ribs will cut across nearly the middle of the length of the *mitral* valve when drawn outwards and downwards by its tendinous cords and columnæ carneæ, and pass about two or three lines above that portion of the *tricuspid* which most nearly approaches it, the latter valve lying underneath the sternum, and the former immediately to its left. A frequent repetition of our observations, and experiments with needles long enough to pass quite across the thoracic cavity and its contents, lead us to believe that the relation of the heart to the parietes is not in all cases accurately the same, though the differences are too inconsiderable to throw any difficulty in the way of diagnosis. They may, however, serve to account for the circumstance of the results given here and at a former page, differing slightly from those of Dr. Hope, who states (p. 3,) that "a line drawn from the inferior margins of the third ribs across the sternum passes over the pulmonic valves, a little to the left of the mesial line, and those of the aorta are behind them, and about half an inch lower down." Again (p. 4,) "The auricular orifices are situated opposite to the interspace between the third and fourth ribs, and the right is rather lower than the left."

If the heart hung vertically within the chest, the aortic valves would be at a considerably lower level than the pulmonic valves, as stated by Dr. Hope; but by the oblique position of the organ, intermediate between vertical and horizontal, this distance, if considered in linear relation to the external surface of the chest and the results of stethoscopic examination, is notably diminished.

The depressed condition of the ribs in the dead body, like a forced expiration in the living, will tend to make the heart in the corpse appear in a slight degree higher up, in relation to the anterior walls of the thorax, than its natural medium site; and for this, allowance ought to be made.—AUTHOR.

When the heart of a living animal is exposed, it is seen that its only fixed and stationary point is at the valves of the aorta; the other large blood-vessels at the base revolve partially

As disease of the heart is rarely, if ever, an affection of the whole organ, it is not from a mere general and superficial inspection of its magnitude, such as the old pathologists seem to have rested content with, that any very satisfactory knowledge is to be expected. It is only by the patient examination of all its component parts in detail, their texture, composition, size, form, and mutual adaptation, that a complete insight into the actual condition of the organ, or an explanation of the various functional derangements which preceded death, can reasonably be hoped for. To make a satisfactory post-mortem examination of the heart, we should begin by ascertaining the state of its investing membrane: and then proceed to lay open its several cavities, so as to enable us correctly to estimate their size, the thickness of their walls, the condition of their valves, tendons, orifices, lining membrane, vessels, and nerves. Perhaps the best method of displaying the interior of the heart, without injury to its orifices, nerves, or tendons, is that adopted by Dr. Williams; namely, to make an incision from the

around this point, and the body of the heart being free, no fixed relation exists between it and the walls of the thorax, but it hangs, in a certain degree, loose, and liable to displacement by changes of posture and by motions of the chest. It is of the first importance, therefore, that the pathologist should be correctly informed as to the precise situation of the semi-lunar valves of the aorta. Repeated observations made on the dead body have proved, that these valves are pierced, if needles be introduced perpendicular to the plane of the sternum through the middle of that bone opposite the middle of the cartilages of the third ribs; and that, if the wires be passed perpendicular to the tangent of the curved surface of the thorax, between the cartilages of the second and third ribs half an inch from the left margin of the sternum, the semi-lunar valves of the pulmonary artery are entered. *The aorta*, from its origin, curves upwards towards the right, extending between the cartilages of the second and third ribs slightly beyond the right margin of the sternum; at the lower margin of the cartilage of the second right rib, the arch of the aorta commences and inclines to the left, crossing the pulmonary artery where it lies beneath the cartilage of the left second rib, and ascending as high as the first rib, turns downwards. *The pulmonary artery*, from its origin in contact with the sternum, commences at the left margin of that bone, where it is joined by the cartilage of the third rib, bulges at the interspace between the second and third cartilages close to the sternum, and dips beneath the aorta opposite the junction of the second cartilage and sternum.

The right divisions of the heart, being most superficial, form the greater part of the anterior surface; the *right auricle* reaches from the cartilages of the third right rib to that of the sixth: and between the third and fourth, where its extent is the greatest, it extends, laterally, when filled with blood, near one inch and one-third to the right of the sternum. About one-third of the right ventricle lies beneath the sternum, the remaining two-thirds being to the left of that bone; the *septum* between the ventricles coincides with the osseous extremities of the third, fourth and fifth ribs, and on the fourth rib is midway between the left margin of the sternum and nipple. A small part, say one-fourth, of the left ventricle, presents anteriorly; and when the lungs are separated, a portion of the left auricle is visible between the second and third left ribs two inches from the left margin of the sternum. With the exception of these portions, the whole of the left ventricle and auricle lie posteriorly to the right ventricle; and the entire left divisions, with the exception of a small portion of the base connected with the pulmonary valves of the aorta, lie on the left of the sternum.

In the dead body, the normal situation of the *tricuspid* and *mitral valves* have been found to be as follows: the *tricuspid valve* extends obliquely downwards from a point in the middle of the sternum immediately below the third rib, to the right edge of the sternum where it connected with the lower margin of cartilage of the fifth rib; the *mitral valve* commences beneath the lower margin of the left third rib, near the junction of its cartilage with its osseous extremity, (two and a half to three inches to the left of the sternum,) and runs slightly downwards, terminating opposite the left margin of the sternum, where it is joined by the cartilages of the fourth rib.

apex of the left ventricle, close along the anterior groove indicative of the septum, taking care to cut between, and not across, the semi-lunar valves, or rather to stop a little short of the aortic orifice, until its ventricular aspect has been examined; whilst, to get a good view of the mitral valve, a second incision is to be carried from the apex up along the middle of the flat surface of the heart. In the right ventricle, the first section is likewise to be carried along the anterior edge of the septum; but the second in consequence of the different position of the tricuspid valve, should commence in the middle of the first, and be carried across the cavity at right angles to the heart's axis, till it meets the posterior groove. The auricles are to be laid open by a crucial incision, which displays their ventricular and venous orifices uninjured, their septum the ossa ovalis, &c.

MOTIONS OF THE HEART.

Notwithstanding all the attention recently bestowed upon the subjects of the sound and motions of the heart, some obscurity still exists in respect to them. Certain facts, however, appear to have been at length satisfactorily ascertained, and to these chiefly we shall endeavour to confine ourselves, leaving the more debateable ground to works treating expressly of the physiology of this organ.

It is known, in the first place, then, that the auricles and ventricles contract alternately, the systole of the auricles being instantly followed by that of the ventricles, and this in its turn by the ventricular diastole, and a momentary period of repose. The full dilatation of the auricles is simultaneous with the contraction of the ventricles: the auricles being distended, a portion of their contents overflows into the relaxing ventricles, and the appendices, after the momentary pause just mentioned, again acting, stimulate the ventricles, by the injection of an additional quantity of blood, to renewed exertions,—a stimulus the more readily obeyed from the inherent tendency in this muscle to periodic action.

Such is the order of succession, now commonly known as the *rhythm of the heart's motions*. Of the whole time occupied by the several elements, which go to make up a complete beat of the heart, somewhere about a half is consumed in the contraction of the ventricles; a fourth in their diastole; and the remaining fourth, as judged of by the ear, is spent in apparent repose, though really the latter portion of it is taken up by the silent contraction of the auricles and their appendices. The impulse of the heart against the ribs, and the pulsation of the great arteries as they arise from it, are synchronous with the ventricular contraction, as has been proved by direct experiment.* The pulse of the arteries at a greater distance from the centre of the circulation is felt a moment afterwards, the interval of time being directly proportional to the distance from the heart. The cause of this retardation is to be found in the yielding and elastic nature of the tubes in which the blood is conveyed, in consequence of which a minute portion of time, as well as a part of the onward force of the ventricular wave, are consumed in effecting the dilatation of the arterial walls. The interval which occurs even in respect to the remoter arteries is still very slight, not exceeding perhaps a quarter of a second, and yet with attention and a little practice it is readily appreciable. Any one may perceive it in his own person, especially when the pulse is rather slow, on applying the fingers of one hand to his posterior tibial artery, as it is passing behind the inner ankle, whilst the fingers of the other are simultaneously placed in contact with that portion of the chest where the heart's impulse is most perceptible.

In the natural condition of the heart, in most postures of the body, the apex alone seems to be concerned in giving the impulse felt externally. Yet in the prone position, or when the body is leaning much forward and turned a little towards

* Drs. Hope and Williams; the Dublin committee of the British Association, for the investigation of the sounds and motions of the heart; [Drs. Pennoek and Moore's Experiments, &c.,]

the left side, after a full expiration, and still more remarkably in cases of enlargement of the organ, its whole mass appears to be impelled forcibly against the walls of the chest.

Various explanations of the impulse of the heart have been attempted; thus it has been ascribed to the reaction of the blood in quitting the ventricles,—to the tilting forward of the whole organ, by a supposed sudden diminution of the aortic curve, under the influence of the straight-forward impulse of the projected column of blood,—to the simultaneous distention and prolongation of the ascending aorta and pulmonary artery,—to the coincidence of the dilatation of the auricles with the ventricular systole,—to the forcible injection of the ventricles by the auricles (an obvious error.)—and, finally, it has been attributed, and with much more probability than appertains to any or all of the other supposed causes, to the sudden tension of the ventricles in their systole, with the accompanying rapid jerking upwards of the apex, in consequence of the greater length of the anterior fibres of the heart, and probably of something in the mode of their disposition which has not yet been accurately ascertained. Any one, indeed, who has ever grasped the heart of a living animal in his hand, must have become satisfied, from the force with which his fingers were separated during the ventricular systole that an adequate explanation of the stroke of the heart was to be found in the action of the ventricles alone, without being much indebted to any of the other supposed causes. A movement of this kind is quite obvious to the sight in the heart of an animal, even a warm-blooded one, for many minutes after its being quite emptied of blood, and even removed altogether from the body.

During its systole, the heart is elongated, its transverse diameter is diminished by the approximation of the walls of the ventricles; the base of the heart at the same time revolves towards the left about one-sixteenth of its circumference, while the apex turns towards the right, thus causing the heart to assume a spiral form. The elongation of the heart, as seen in the sheep, was ascertained in the experiments of Drs. Pennock and Moore to be one-fourth of an inch, measured from the aortic valves to the apex.

During the diastole, the transverse diameter of the heart increases, and that organ assumes a rounded appearance. G.

The auriculo-ventricular valves are slightly raised from their contact with the sides of the ventricles, by the tendons passing into them from the *columnæ carneæ*, synchronously with each ventricular contraction, so as to facilitate the insinuation of the blood behind them; and by means of this latter, their complete closure is eventually affected,* and all reflux in the natural condition prevented, at least in the left side of the heart; for, with respect to the right side, it has been remarked by Hunter, that the valves do not accurately close the auricular and arterial orifices,—this being a provision of nature, he conceived, to allow a partial reflux, into the auricle, when, from any cause, the passage of blood through the delicate texture of the lungs is obstructed, as is often the case during violent efforts, narrowing of the left apertures of the heart, disproportionate magnitude of the right cavities, &c., and similar views have recently been advocated by Mr. Adams and Mr. King, who looked upon the tricuspid as exercising a kind of safety-valve function. The dilatation of the ventricles is effected in part by their own elasticity, which will suffice to draw a certain quantity of blood into them; and is probably completed by the auricles transferring as they contract, an additional portion. Some physiologists call in, moreover, the aid of an active dilating power in the heart, but of the reality of this, though not improbable, no absolutely convincing proof has yet been adduced. The feebler muscular structure of the auricles, and the absence of a valvular apparatus at their great venous orifices, indicate sufficiently that the propulsive power of these cavities is but slight in comparison with that of the ventricles, and that they play consequently a very inferior part in the business of the circulation.

* Hence M. Bouillaud has denominated the *columnæ carneæ*, the tensor muscles of the tricuspid and mitral valves. G.

For its motions, the heart, like all other muscles, is primarily indebted to its own inherent contractility, as is obvious from their continuance long after its removal from the body. For nervous influences it is chiefly dependent on the ganglionic system, and not on the spinal marrow. This opinion, advocated by Willis and Bichât, and subsequently impugned by Legallois, may now be considered as fully established by the experiments of Dr. W. Philip, Mr. Clift, and Brachet. The pathological facts, recorded by Lallemand and Lawrence, of the pulsation of the heart in a monstrous fœtus, where the brain and the spinal marrow were entirely deficient, afford additional evidence, if any were wanting, that these organs are not essential to its action. Injuries of the spinal cord, it is true, powerfully affect the heart; but this is now known to take place merely through the medium of sympathy, and similar results equally ensue from extensive and destructive injuries of other parts of the system. That the heart is remarkably under the influence of mental emotions is familiar to every one—but in this there is no contradiction to the views just expressed, nor any infringement of general analogy.

NATURAL SOUNDS OF THE HEART AND BLOOD-VESSELS.

When we apply the ear to the region of the heart, with or without the intervention of the stethoscope, two sounds are heard, of which the first is duller and more prolonged, synchronous with the pulse in the immediate vicinity of the heart, and consequently with the contraction of the ventricles. The second, which instantly succeeds it, is of a more abrupt and clearer character, and is followed by an interval of silence.

The first sound is loudest over and below the middle of the ventricles; that is, over that portion of the heart which is in contact with the parietes; the second over the semi-lunar valves, and for a short way upwards along the sternum. They are most easily distinguished, by the uninitiated, in thin individuals of a slight and narrow make, and when the pulse is somewhat slow. We may occasionally, in particular states, hear them very distinctly in our own persons, especially when lying on the left side, and when the pulsations have been rendered more energetic by violent exercise or the use of stimulents; and in certain disorders of the heart this audibleness of its workings becomes almost a constant, and with some patients, a very distressing symptom. These sounds are sometimes audible even to a by-stander at a little distance from the patient. Thus Laennec states that he had heard them at various distances, from two inches to two feet from the chest, through the medium of the air alone; and he speaks of cases, on hearsay, where the beating of the heart was heard in an adjoining chamber to that in which the individual lay. Mr. Breventani, a recent Italian writer, has met with two cases in which the morbid sounds of this organ were audible at a considerable distance, which in one is specified as being not less than three paces.

According to Laennec and many of his followers, the sounds heard under the inferior part of the sternum belong to the right cavities;—those under the cartilages of the left lower true ribs, to the left. In cases of the morbid enlargement of particular parts of this organ, such distinctions may doubtless be attempted with success, but in its natural condition we agree with Mr. Bouillaud in doubting their practicability, when we take into consideration the limited extent of these cavities, their close apposition, and the manner in which the right ventricle lies over, and in front of, the left.

A marked difference exists in the systolic sounds of the right and left ventricles. This difference, which is particularly striking upon ausculting the exposed heart of a living animal, is also observed in the examination of the chests of patients, even when the heart is in its normal condition. The first sound produced by the contraction of the left ventricle, as heard near the left nipple, being duller and more prolonged than that of the right, heard at the sternum, where

it is clearer and shorter. These differences are referrible to the relative thickness of the walls of the right and left ventricles.

The examination of the sounds of the heart by the flexible stethoscope, greatly facilitates the diagnosis of the precise seat of the lesion, and with great attention it may be generally diagnosed with certainty. G.

The intensity of the heart's sounds diminishes in the natural condition in proportion chiefly to the distance from the præcordial region. Laennec has certainly limited the extent of surface in which they are audible, in a healthy well-proportioned individual of moderate fatness, within too narrow bounds, when he confines it to the præcordial region alone. In very fat persons he states that it is confined to a space of about an inch square. In narrow-chested thin individuals and children, these sounds may often be heard over the greater part of the thoracic cavity, posteriorly as well as anteriorly; in the neck, and also in the epigastrium, though no disease of the heart exists: and in infants that may sometimes be heard even as low as the buttock.

Disease of the heart itself, or of the neighbouring organs, produces remarkable modifications in regard to the intensity and mode of diffusion of these sounds, which are of high importance in respect to diagnosis. Thus they may appear even louder at remote parts of the chest than in the more immediate proximity of the heart; as, for example, when a portion of the lungs is solidified and rendered a better conductor of sound by inflammation, or by tubercular infiltration or condensation around a phthisical cavity, or by the compression resulting from pleuritic effusion, or by the development of a tumour within the chest, or the encroachment of an enlarged liver on this cavity.

When, from morbid changes inherent in the heart itself, variations arise in regard to the extent in which its sounds are perceptible, they manifest themselves, according to Laennec, successively in the following order:—1. Sounds audible in the left side of the chest, from the axilla down to the corresponding hypochondriac region; 2, in the right side, over the same extent; 3, in the left posterior portion of the chest; 4, but rarely, in the right posterior region. But the practical applicability of this scale, to which Laennec attributed much importance in determining the nature and degree of cardiac disease, is obviously greatly limited by the interference of the several extraneous circumstances to which we have just alluded.

The *physical cause* of the sounds of the heart has been the subject of much discussion. To enter upon a minute estimate of all the theories proposed for their explanation would be inconsistent with the practical nature of this work; we shall therefore limit ourselves to stating our conviction that the great weight of evidence is in favour of the two following causes:—muscular contraction for the first sound, and valvular reaction for the second. It has been rendered in the highest degree probable, by the experiments of Dr. Williams and others, that the *first* sound is an example of the “*bruit musculaire*,” or sonorous muscular contraction, of Erman, Wollaston, and Laennec. All powerful muscles, as the biceps of the arm, the masseter, or the abdominal muscles, if thrown into strong action, gives rise to sonorous vibrations which may readily be heard in our own persons with the aid of a flexible air-tube. That the muscular sound of the heart may occasionally be modified by the stroke of the organ against the side of the chest in the case of violent palpitation, and also in some degree by the action of the auriculo-ventricular valves, is not denied; but the first sound is not mainly dependent on either of these, for it is still audible even after the removal of the heart from the chest, and when consequently it has no longer either the thoracic parietes to strike against, or blood enough to ensure the action of the valves (*Dublin and London Heart Committee—Williams [Pennock and Moore.]* Even the complete obstruction of these valves, by inverting the auricles and thrusting them thus into the auriculo-ventricular openings, [or cutting away the valves,] was not found to annihilate the first sound. After the promulgation of such facts, it is sur-

prising to find that so able a writer as M. Bouillaud should persist in attributing it solely to valvular action: and even although independent of these facts, the prolonged character of the sound appears quite incompatible with the sudden and momentary tension or collision of such membranous structures.* This promulgation reaches its maximum in cases of great hypertrophy, and especially when the ready escape of the blood from the ventricles is interfered with by the diseased narrowing of the arterial orifice.

The contraction of the auricles, according to the experiments of Drs. Pennock and Moore, produces a slight sound, which, occurring at the commencement of the first sound, is merged in that of the ventricular systole. G.

With regard to the *second* sound, it has been rendered equally probable by the experiments of Elliot, Carswell, Rouanet, Carlyle, Williams, Hope, [Pennock, Moore,] and the committees already alluded to, that it depends on the reaction of the column of blood in the artery against the semi-lunar valves; for it is found to cease, or in some cases to be supplanted by a hissing noise, on these valves being hooked up, and held nearly immovable against the sides of their respective vessels, by a curved needle introduced through their walls from without. It is likewise put an end to on arresting the current of blood, either by cutting across or compressing these vessels near their origin, and so preventing the falling back of the arterial column against the valves. Making a small opening into the great arterial trunks near their source very materially modifies the second sound (*London Heart Committee*;) and even cutting across the carotid, by diminishing the arterial tension, greatly enfeebles the same, as does likewise whatever lowers the projectile energy of the ventricles, the reaction of the great vessels being of course proportional thereto. The circumstance of these sounds being loudest in the region of the semi-lunar valves, and commencement of the aorta and pulmonary artery, tends still farther to confirm the truth of this hypothesis.†† We are inclined at the same time to think it probable that the second sound, though mainly produced in the way just stated, may yet in

* According to Dr. Hope, the causes of the first sound are compound; consisting, 1st, of valvular sound (and to this he seems still to attribute the most importance;) 2d, the sound of extension,—a loud smart sound, produced by the abstract act of sudden jerking extension of the braced muscular walls; 3d, a prolongation, and possibly an augmentation, by “bruit musculaire.” P. 50.—AUTHOR.

† The discovery of this theory of the second sound of the heart, is claimed by Dr. Carswell, and was first publicly announced by M. D’Espine, in a dissertation read by him at the Academy of Medicine at Paris, in July, 1831, though it was made known by Dr. Carswell as early as 1829. There is, in the museum of University College, a drawing (dated 1829) of the case of aneurism of the aorta observed by Dr. Carswell, in the Hospital of La Charité, the physical signs of which case first suggested to him this now almost universally received theory.

[Dr. Billing attributes both sounds to the valves alone. See Essay read at the Hunterian Society, Feb. 9, 1832, reported in the *Lancet*, May 19, 1832; also *Principles of Medicine*, Preface, p. 21.]—AUTHOR.

† The presence of coagula in the ventricles, or the preternatural congestion of these cavities from inflammation of the endocardium, prevents the formation of the second sound. In Drs. Pennock and Moore’s experiments, it was observed that the second sound ceased upon congestion of the heart taking place—that the right ventricle became congested before the left, and that this congestion invariably obliterated the second sound on the right side, whilst the sounds continued normal over the left ventricle until congestion took place in that cavity. These facts are corroborative evidence that the second sound is caused by the reaction of the column of blood upon the semi-lunar valves by which they become tightened and closed. G.

the natural condition, and when the heart is acting energetically, be re-enforced by the diastole of the ventricles: we do not mean to assert that this has been as well made out by experimental evidence as the cause first mentioned; but if as is now known to be the fact, the relative change of place undergone by the constituent molecules of a muscle in the act of contraction be accompanied by the production of sound, we should expect that the elastic recoil of so powerful a muscular organ as the heart, *i. e.*, the rapid return of these same molecules in their former state, would likewise be accompanied by the same phenomenon, though differing somewhat in character or intensity.

This theory is ingenious; but from the fact of the entire absence of the second sound when the closure of the semi-lunar valves is prevented by ossific or cartilaginous depositions, or where the reaction of the columns of blood upon the valves is prevented by extensive ossification in the aorta or pulmonary arteries near the valves, or by an aneurismal tumour, we should consider it untenable. G.

MORBID SOUNDS OF THE HEART AND BLOOD-VESSELS.

Amongst the most common changes in the sounds of the heart, is *increase or diminution of intensity*. Thus, in the first place, they may become so feeble as to be heard with difficulty; and this may depend either on general debility of the whole system, or on that of the heart in particular; on obstruction of the pulmonary circulation; on excessive afflux of blood to the heart; on softening of this organ; or, finally, on its extreme hypertrophy, the overgrown muscular mass contracting less perfectly than in the natural condition, and being ill adapted for the production of sound, and at the same time a bad conductor of it. The sounds of the heart may become so loud, on the other hand, as to be audible, as we have already seen, at some distance from the chest. The great majority of the latter cases, as mentioned by Laennec, are quite independent of organic lesion, being mostly instances of nervous palpitation, or the temporary result of violent muscular exertion, the natural sound being not only increased itself, but re-enforced moreover by the addition of a metallic ringing sound, caused by the unusual impulse against the walls of the chest.* Dilatation of the ventricles, and thinness of their parietes, are also particularly favourable to the augmentation of the cardiac sounds, and tend in a remarkable degree to assimilate the first sound to the second.

The natural character of the sounds of the heart may be still farther altered or masked by the supervention of the *bellows sound* (*bruit de soufflet*), of various qualities or degrees of intensity; the *simple blowing sound*, the *hissing*, *sawing*, or still hoarser *rasping* sounds, all of which are occasionally to be heard in the arteries also, and more especially in the carotid and sub-clavian, the abdominal

* Dr. Davies mentions, in his lectures, having heard the beating of the heart of a patient (a female during menstruation) at five or six yards distance. Laennec, when on his death-bed, heard his own heart beat very distinctly, and it was audible at some inches distance to the by-standers. He had been blooded shortly before. He ascribed the phenomenon to distention of the stomach with air, as it ceased immediately after eructation.

Dr. Hope doubts the possibility of sound ever being produced by the impulse of the heart against the walls of the chest; believing this organ to be always, in consequence of the atmospheric pressure, necessarily in contact with the parietes. As to the accidental metallic "cliquetis," sometimes heard during palpitations, he ascribes it to the apex, as it glides forwards and upwards in systole, catching against the inferior margin of the fifth rib, having observed it to occur only in the thin subjects, and that it can be done away with at once by pressing with the stethoscope into the intercostal space, so as to obliterate any internal depression at this part.—AUTHOR.

aorta, and the great arteries of the limbs; as also in the uterine, or adjacent arteries, during pregnancy. Even in the natural state of the arteries, a species of low murmur, compared by Bouillaud to that produced by rubbing the point of the finger against the thumb, as in the action of giving a fillip, accompanies each pulse-wave. On pressing more firmly with the stethoscope, this becomes converted into a "bellows murmur." This has appeared most audible when from deficiency of blood, the arteries are less distended than usual, and also when the blood is more watery than ordinary. The sound in question depends, according to Bouillaud, on friction, and may be imitated by injection of the arteries in the dead body, or by driving a fluid in jets through any elastic tube. Dr. Corrigan, on the contrary, from observing the bellows sound to be most intense beyond the point of pressure with the stethoscope, and that it was produced by any condition tending to disturb the natural equable motion of the blood, was led to conclude that it depended, 1st, on a current-like motion of the fluid, tending to produce corresponding vibrations in the sides of the cavities of the heart or arteries; 2dly, on diminished tension of their parietes, in consequence of which they are more easily thrown into such vibrations. Dr. Williams and Dr. Todd, on the other hand, from a somewhat similar set of experiments to those previously instituted by Dr. Corrigan, came to a different conclusion; namely, that a certain resistance or impediment to a liquid current is the essential physical cause of all murmurs produced by the motion of fluids in elastic tubes; and that any particular condition of the walls of the tube beyond the obstructing point is not essential to their production.* It is possible that here, as in so many other cases, truth may lie between; and that we might be justified in adopting an hypothesis combining the views of both parties. Thus it seems nowise improbable that the sonorous vibrations in question are caused by a current-like motion of the contained fluid; but that this acts first, chiefly, on the narrower portion of the canal, where the friction is greatest, and the pressure of fluid on the farther side least; whilst the vibratory motion so generated is immediately propagated to the laxer parts beyond.

There is another rarer modification of this phenomena, first noticed by Laennec, but met with by him only in the arteries, wherein the blowing sound assumes somewhat of a *musical* or whistling character; occasionally ascending and descending through two or three notes of the gamut in a sliding or slurred manner, and accompanied by a slight thrill in the artery perceptible to the fingers. Of its affinity to "bruit de soufflet" we have proof in the fact of its sometimes supervening insensibly on the ordinary bellows-murmur when the patient is agitated, and again falling back gradually into its former character. It may be either intermittent and synchronous with the pulse, or continuous. It seemed generally to Laennec to be connected with a nervous habit of body, or with a chlorotic condition, quite independent of organic disease. He cautions us against confounding it with a somewhat similar, or chirping sound, which is occasionally, produced in

* Dr. Corrigan, as appears from a recent paper in the *Dublin Medical Journal*, still adheres to his original opinion; and undertakes to prove that impediment in a tube alone is not sufficient for the production of sound,—for if a second and more considerable constriction be made lower down, the bellows-murmur in the upper and original one ceases as soon as the whole tube has become full and tense. His views are, as usual, supported with much ingenuity; and the question at issue, though supposed to have been set at rest by the investigations of the London Heart Committee, must be considered perhaps as still undecided. It seems to us, however, that he does not take sufficient account of the diminished velocity of the fluid, and consequent reduction of friction, taking place in the arrangement just alluded to. The increased pressure of fluid against the remote side of the upper obstructed portion must also tend to impede the production of vibrations in the part. In respect to the sound generated at the very extremity of a tube discharging a fluid, he supposes the surrounding air to take the place of the flaccid parietes of the tube, and to respond to the vibrations of the rushing stream so as to produce an audible murmur.—AUTHOR.

some of the bronchial ramifications from the presence of mucus and the pulsation of the sub-clavian artery against the top of the lungs. M. Bouillaud has twice met with a similar musical sound in the heart itself, and compares its varieties to the cooing of the wood-pigeon, the chirping of small birds, or the sibilant râle of bronchitis. It is supposed by him to be connected with narrowing of the orifices or disease of the valves, and to be only a very intense form of the bruit de soufflet. M. Rouanet has also met with it in the same situation, as have likewise Drs. Forbes, Hope, and Elliotson; and in some few of these instances it has been connected with the existence of a long végétation attached to the mitral valve.

To a singular variety of the bellows-murmur; of a remittent becoming or whirring character, occasionally heard in chlorotic and nervous subjects, with too fluid or watery a state of the blood and an easily accelerated circulation, particularly above the inner end of the clavicle in the neighbourhood of the carotid and sub-clavian artery and jugular veins, M. Bouillaud has given the fantastical name of "bruit de diable," from its similarity to the noise produced by the well-known French toy resembling a double humming top, called the "devil on two sticks." It is not absolutely intermittent or interrupted, like the ordinary bellows sounds, nor yet equably continuous like another species in which the sounds accompanying the two motions of the heart run, as it were, into one; but, though sustained or prolonged from pulse to pulse, it has remissions of intensity, and a periodic swell, bearing a fixed relation to the diastole of the arteries, in which vessels, according to the author just named, it has its origin. Dr. O. Ward has, however, rendered it probable that its seat is very often, if not always, in the external jugular veins (*Med. Gaz.*: April, 1837;) an opinion which is likewise embraced by Drs. Williams and Todd, and has been still more recently advocated by Dr. Hope. Very slight circumstances suffice to alter its character, or to interrupt it: such as, a change of posture; relaxing the side of the neck on which it is heard; pushing over the larynx; muscular efforts which impede the respiration; and the transit of blood through the lungs and right side of the heart; increased pressure of the stethoscope, or compression of the vein above: whilst, on the other hand, it is increased in intensity by whatever puts the vessels on the stretch (as averting the head and raising the chin,) and which, by narrowing their caliber, augments the velocity of their current. Dr. Ward admits that it may sometimes be modified by the proximity of the carotid arteries; so as to appear augmented at each ventricular systole. Dr. Williams does not consider it essentially a morbid sound, as it may be produced at pleasure in the healthiest subject by the pressure of the stethoscope in the region indicated above, so applied as to effect only the venous current. It has likewise been observed, though more obscurely, in the superficial veins of the limbs. An analogous sound is mentioned by Andral under the title of "bruit de mouche," from its close resemblance to the buzzing of a fly. It differs, however, in being continuously sustained and equable, not being periodically re-enforced like that just described; and is supposed by him, though perhaps erroneously, to have its seat constantly in the carotids, and always to indicate a chlorotic condition, and the propriety of administering iron and other tonics. It seems probable, from the investigations of the gentlemen previously mentioned, that this sound also very commonly originates in the veins, and that the pressure of the muscles of the neck may sometimes be concerned in its production.

The *causes* of the *arterial* abnormal sounds are reducible to the following heads:—1. Compression as by a tumour or the stethoscope (murmur blowing.) 2. Contraction of caliber, roughness of the lining membrane, or other partial impediment (murmur blowing, musical, rasping, &c.) 3. Sudden dilatation, which is so often observed in the ascending aorta, and sometimes in the pulmonary artery, rendering their diameter disproportionate to that of their orifices (murmur, generally grating.) 4. Aneurism (murmur, whizzing or grating.) 5. Passage of blood through an accidental opening in an artery into a vein (aneurismal varix; murmur generally whizzing or grating.) In addition to these causes, which are obviously of a mechanical nature, must be enumerated augmented action of the

heart, a thin condition of the blood, and a nervous habit; for these conditions seem adequate not merely to augment and modify the morbid sounds, but even alone, or at least in the absence of any permanent obstructing cause, to originate them. (*Williams.*)

Narrowing of the orifices of the heart also; or an irregular, rugose, shortened, or imperfect condition of the valves, connected generally with cartilaginous or ossific degeneration, obstructing the onward course of the blood, or permitting of reflux, is commonly accompanied by some of the above-described varieties of morbid sounds. This is the result of M. Bouillaud's experience, and, we believe we may add, of most physicians who have seen much of disease of the heart. The frequency of the coincidence was admitted even by Laennec, though he did not look upon the latter as the immediate or necessary effect of the former. M. Piorry, however, asserts that neither the bellows-sound nor any of its modifications were present in one case out of twenty within his own sphere of observation. Now, as we have already stated in another place (*British and Foreign Medical Review*, No. ii. p. 451,) when negative evidence is thus set in opposition to positive, we are impelled by a law of our nature to give most credence "*cæteris paribus*;" to the latter, and to suppose it more probable that existing sounds may have escaped notice on the one hand, than that their existence should have been fancied and recorded when they had no reality on the other. We do not, however, deny that cases of contraction and ossification may occasionally present themselves unaccompanied by any abnormal sounds. They are, however, we apprehend, extremely rare, and form only the exceptions, and not the rule, as M. Piorry would have us believe. We are equally prepared to admit that these sounds often exist without its being possible to connect them with any obvious physical lesion.

Bruit de soufflet may originate within the heart, according to M. Bouillaud, from any of the following sources:* 1st, narrowing of the orifices; 2d, smallness of the aortic orifice, even when the valves are perfectly healthy. This condition, whether congenital or acquired, co-exists very often with dilatation or hypertrophy of the left ventricle,—circumstances which will necessarily add much to the intensity of the sound; also a similar condition of the pulmonary orifices, but this is much more rare. 3d. Vegetations and calcareous incrustations in the valves, with irregularity of their surface, even when their efficiency has not been altogether destroyed thereby, nor the size of the orifices notably affected. 4th. Infiltration of the valves and deposition of fibrinous matter or coagulable lymph on them, in inflammation of the interior of the heart.† 5. Polypus concretions formed during life, occurring chiefly in the disease just named. 6th. Præternatural adhesions of the auriculo-ventricular valves to the adjacent parietes of the heart. 7th. Dilatation of one or more orifices of the heart, with consequent in-

* Much of what is here said on the sounds and motions of the heart is taken with little alteration, from the article alluded to above. Dr. Copland, too, in his valuable Dictionary, appears to have drawn largely and almost literally from the same source; in one instance even an error of the press has been inadvertently retained. In alluding to this subject we do not mean, in the slightest degree, to censure the learned author for availing himself of every means of facilitating and accelerating the progress of his laborious and admirably executed undertaking; but mention it merely in order to establish at least an equal right on our part to make use of the products of our own previous labour.—AUTHOR.

† The bellows sound is a very frequent accompaniment of pericarditis also, and has generally been ascribed to the mere increase of action in the ventricles; but Dr. Hope, M. Bouillaud, and others have shown that it really depends, in such cases, on the co-existence of inflammation of the internal lining of the heart, and the morbid changes in the valves and orifices just mentioned. The "*bruit de frottement*," or rubbing sound, afterwards to be spoken of, which depends on coagulable lymph effused on the surface of the pericardium, might also, by the incautious, be mistaken for the "*bruit de soufflet*."—AUTHOR.

efficiency of the valves. 8th. Hypertrophy with dilatation of the ventricles, even though unattended by narrowing of the orifices; but here the bellows-sound is generally intermittent, and only well marked at such times as the motions of the heart are unusually accelerated. 9th. A chlorotic or nervous condition, the peculiar sound in question occurring during the presence of palpitations. 10th. Great and sudden debility from hæmorrhage and other lowering causes. Dr. Hope, in a series of experiments performed in conjunction with Dr. M. Hall, ascertained that the bellows-murmur, in conjunction with a rapid small pulse, can be produced at pleasure in the lower animals by repeated abstractions of blood; and it has here been supposed to depend on a narrowing of the cavities and orifices, which thus endeavour to adapt themselves to the diminished quantity of fluid circulating through them, and consequently no longer bear a due proportion to the great vessels springing from them; and it has also been in part ascribed to the unnatural tenuity of the blood,* and to what is probably the most indispensable condition of all—the increased rapidity of its current caused by the spasmodic vehemence of the heart's contractions; for, that a tendency to spasmodic action in all muscular parts is an ordinary consequence of extreme depletion, is incontestible. Laennec, as is well known, supposed all these sounds, in every case, whether in the heart or arteries, to originate not in organic lesion, but in simple spasm. This was, however, to take quite too limited a view of their nature. It seems impossible to conceive that the various sounds occasionally taking place in the heart and arteries should ever have been attributed to any thing but a determinate physical cause, however difficult it might be in particular instances to ascertain its precise nature. Laennec, indeed, has been taunted with referring them merely to a “peculiar modification of the innervation,” but his context shows plainly that this was considered only a link in the chain of causation; the immediate condition necessary for their production being obviously a contracted or otherwise obstructed or altered state of the parts concerned, which, from the frequently intermittent nature of the phenomena, he supposed ordinarily, as just mentioned, to be the result of spasm, or of a vibratory or intermittent action, such as produces the “bruit musculaire” already alluded to.

In nearly all the cases enumerated above, an increase of friction in respect either to the onward or reflux current, originating in disproportionate size, irregularity of form, roughness or obstructing substances in the orifices of the heart or in the vessels, is probably the chief source of the phenomenon in question; its proximate cause consisting in a tremulous motion in the solid parietes of these parts, and a rippling eddying flow in the fluid within them: such at least are the principal conditions requisite for the production of sound in other hollow sonorous bodies.

It might appear at first sight very difficult, if not impossible to ascertain, by means of these abnormal sounds which of the orifices of the heart, if any of them, is diseased; for though the murmur may be coincident with the ventricular contraction, it may depend either on the rush of blood through a diseased aortic or pulmonary orifice, or on reflux through the auriculo-ventricular openings,

* This thinness of the blood seems to be a very important element in the production of inorganic murmurs. Thus it is almost solely in anæmic and chlorotic individuals, that the venous murmur already alluded to occurs. The tone and accidental degree of tension of the parietes of the vessels, and the state of the nervous system, appear also to have a great influence in their production.

It is a remarkable fact, pointed out some years ago by Dr. Elliotson, that it is invariably during the ventricular *systole* that such cardiac murmurs as are independent of organic disease occur: for in the diastole no regurgitation can take place through the healthy semi-lunar valves, and the *onward* current setting in through the auricular valves is too feeble for the production of sound. Dr. Hope's experience not only confirms this fact, but leads him still farther to limit the occurrence of murmurs of this species to the aortic orifice. On the latter point, however, he is at variance with some other observers.—AUTHOR.

or both; and if, on the other hand, it co-exists with the diastole of the ventricle, it may originate either in reflux through the former openings, or depend on a morbid alteration of the latter, or both conjointly.* Attention to the situation in which the murmur appears loudest or nearest, and its relation to the pulse, will however commonly greatly aid us in forming a diagnosis. Thus, if it be most intense over the apex and middle of the ventricles, we may conclude that it originates in one of the auriculo-ventricular orifices (generally that of the left side,) and that it is caused by the *entry* of blood if it anticipate the pulse, or by the *reflux*, if it coincide with the same. Again, if the maximum intensity of the sound be higher up, as in the upper half of the sternum, *i. e.*, in the region corresponding to the sigmoid valves and commencement of the great vessels, we may gather that the obstruction exists in the orifice of one of the great arterial trunks, most probably the aorta and almost certainly so if it be the loudest to the right of the mesial line,—depending, if coincident with the first sound of the heart, on the onward wave of blood; if with the second, on the reflux; and if continuous, on both.† The history of the case, the investigation of the general and local symptoms, their degree of intensity, permanence, or variability must never be overlooked in our endeavours to ascertain its seat and nature. But to this subject we shall have occasion to recur when we come to treat of endocarditis and its organic consequences, valvular disease, narrowing of the apertures of the heart, as well as of the functional disorders of the organ.

A bellows sound is sometimes produced by the action of an enlarged heart against the portion of lung interposed between it and the walls of the chest, as has been noticed by Laennec, Hope, Law, and others. It has been suggested, by a recent anonymous writer in the *British and Foreign Review* that the seat of compression in such cases may be “one or more of the larger bronchi, and that, when considerable, the impediment to the entrance of air into the corresponding portions of the lung is sufficient to produce a succession of interrupted rushings of that fluid during the efforts of respiration, which are not to be distinguished as sounds from those depending on the heart itself,” till we cause the patient to hold his breath, when it immediately disappears, and the true nature of the case becomes apparent. “Its existence on the right side or the left, its affecting the upper or lower lobes of one or both lungs, may assist our conclusions as to which side of the heart is principally affected. Interrupted respiration, voice, and cough are necessarily propagated in the lobe where the ramifications of the compressed bronchi terminate; and diminished respiration, with accumulated bronchial secretion, are among some of its secondary effects.”‡

A *thrilling vibratory sensation* is sometimes imparted to the hand when firmly

* These difficulties have been recently greatly diminished by the labours of Dr. J. C. B. Williams, and also by those of Dr. Hope, detailed in the last edition of his “*Treatise on the Heart.*”—AUTHOR.

† It is highly probable, as suggested by Dr. Williams, that the intermitting regurgitant murmur in the heart, occurring more especially in nervous patients and young females, may be occasionally connected with irregular action of one or more of the columnæ cornæ; in consequence of which, some of the tendinous cords passing into the auriculo-ventricular valves are not drawn upon exactly in the same degree with their fellows, a chink admitting of reflux of the blood being the necessary consequence.—AUTHOR.

‡ The mechanical influence of the heart or great vessels on the lungs, in the healthy state, is exemplified in the phenomenon described by Dr. Mollison under the title of “the pulmonic pulse,” which consists in the expulsion of a certain quantity of air from the chest synchronously with each contraction of the heart, as ascertained by introducing a bent glass tube into the nostril, and observing that even while respiration is suspended, the fluid in the curve of the tube moves backwards and forwards near a third of an inch with each beat of the pulse. He ascribes it to the compression of the bronchial ramifications by the diastole of the pulmonary arteries which run alongside of them.—AUTHOR.

applied to the præcordial region. To this phenomenon first noticed by Corvisart, and by him supposed diagnostic of narrowing of the aortic orifice, Laennec gave the title of "*fremissement cataire*," or *purring tremor*, from its similarity to what we feel on touching the back of a cat in the act of purring. A sensation of the same kind is experienced on touching various bodies in strong vibration, as the outside case of an organ, for example, while the instrument is played upon; or the larynx of a person who is singing or speaking loud; or an aneurismal varix. It is very analogous to the sensation occasionally produced by the friction of the opposing surfaces of the pleuræ when rendered rough by concrete lymph, or to that felt in some cases of emphysema of the lung.

A similar thrill often exists in the arteries also, sometimes simultaneously with that in the heart, but occasionally quite independent of it. In both it seems to originate in augmented friction, caused in the one case by contraction or obstruction in the orifices of the heart, and in the other by a partial or local diminution of caliber or impediment in some of the arterial tubes. In both instances it is commonly accompanied by the bellows-murmur, generally of a grating character, and acknowledging an identical origin. Ossification of the valves, especially of the left side of the heart, and of the fibrous rings from which they spring, is a very frequent, though by no means the invariable, cause of this jarring sensation. Laennec, though well aware of its frequent co-existence with organic lesion, yet as he observed that the connexion was not invariable, conceived that its immediate source must be of a spasmodic nature; and even Bouillaud admits that in many instances no permanent cause of narrowing is demonstrable, and confesses that we have not yet attained to a satisfactory knowledge of all its possible causes. One, however, in addition to those above mentioned, about which there can be no doubt, consists in friction of the opposed surfaces of the pericardium when coated with an irregular layer of lymph, as in a certain stage of pericarditis; and here the thrilling tremor is accompanied by a grating or rustling sound (the "*bruit de frottement*," *rubbing* or *to-and-fro sound*, synchronous with the actions of the heart;) and sometimes by a *creaking sound*, which has been well compared by Collin to that produced by new leather in a shoe or saddle, and is obviously connected with a certain degree of firmness and tenacity in the false membranes lining the inflamed surfaces. A rough ossific deposit projecting on the outer surface of the heart has likewise been known to give rise both to the tremulous feel, and to a harsh scraping sound. The pericardial "*bruit de frottement*" is distinguishable from a similar phenomenon taking place on the surface of the lungs in pleurisy and emphysema, by being synchronous with the motions of the heart; it is generally strongest in the systole, and may be discriminated from diseased valvular sounds by being diffused over a larger surface.

DISORDERED MOTIONS OF THE HEART.

The heart is liable to various irregularities in its action; amongst these are to be reckoned double or triple impulse, depending generally on spasmodic and partial contraction of the ventricles and perhaps occasionally also, though rarely, on the diastole of these same cavities, when morbidly dilated (back stroke of Dr. Hope,) or, more rarely still, on the transmission of the auricular action.* It is subject likewise to intermittence; to inequality in the strength of successive beats; to diminished energy, under the influence of lowering causes both moral and physical, obstructed pulmonary circulation, over-distention, and thinning or softening of the organ itself; and, on the other hand, to sudden or gradual and great increase in the force and frequency of the pulsations, which may be so violent and tumultuous as to give a disagreeable impulse to the ear of the observer, shaking

* The reality of this last cause, though advocated by high authorities, is still liable to some doubt.—AUTHOR.

the whole frame of the patient, and even the bed on which he lies, and being attended with a distressing internal consciousness of their presence. The more permanent these and other deviations from the natural condition may be, the more gradual in their supervention, and the more independent of extraneous exciting causes, the greater room is there to apprehend that they originate in organic disease of the heart. The power of diagnosing morbid states of the heart's sounds and motions, necessarily implies a correct acquaintance with their natural states, and with the degrees of variation in different individuals, consistent with health; for the loudness of the former, and the extent and energy of the latter, are susceptible of various shades of difference within this limit.

The extent of surface over which *the shock* of the heart is felt, varies much in different morbid conditions: thus in cases of great hypertrophy and dilatation it may be perceptible over a space of five or six inches square, its force being at the same time augmented, and its action assuming a slow, heaving, irresistible character, in proportion as the former morbid condition prevails; and being, on the other hand, diminished in proportion as the dilatation is of a passive nature. In concentric hypertrophy, on the contrary, or that in which the thickening takes place at the expense of the capacity of the cavities, the extent of impulse is scarcely, if at all, greater than natural, though the shock thus circumscribed becomes very forcible and hammer-like. In cases where close adhesions have been contracted between the heart and pericardium, and between this latter and the adjacent lungs and parietes, the place and extent of impulse are, as we have already seen, less affected by posture, and the different states of the chest in expiration and inspiration, than in the natural condition. Again, when fluid exists in large quantities within the pericardium, whilst the impulse is greatly diminished, the points in which it is felt at successive moments are often very variable, the organ being no longer in any degree restrained or directed in its movements by the enveloping sac. Of extraneous circumstances, modifying the extent and situation of the heart's impulse, this is not the place to speak.

A *palpitation* is a beating of the heart disagreeably perceptible to the feelings of the patient, the pulse being commonly more rapid than in the natural state, and occasionally unequal in respect to strength and frequency. Palpitations are often not only felt, but heard also, by the sufferer, and this more especially when in the lying posture. Yet sometimes, even though the pulse may be very quick, and the palpitation greatly complained of by the patient, no increase of impulse is felt on applying the hand to the pericardium; and here, particularly if there be considerable morbid augmentation of sound, dilatation of the ventricle may be suspected. If, on the contrary, during the palpitation, the ear of the observer be thrown up very forcibly and over a much greater extent than naturally, hypertrophy is indicated, even though the pulse should be small and feeble. The stethoscopic examination, to be worthy of trust, must, however, be made neither when the circulation is temporarily excited under the influence of mental emotion, or by some extraneous cause, as unusual exertion, febrile excitement, a stimulant diet, or overloaded stomach; nor yet when the patient's strength is greatly reduced by depletion, inanition, depressing passions, or approaching dissolution, or even by the long continuance of the attack of palpitation, or of a fit of difficult breathing; as at such times the beat of the heart, even though the organ be decidedly enlarged, may yet from exhaustion scarcely be felt. When hypertrophy and dilatation co-exist, the impulse and sound, and the extent in which they may be perceived, are all simultaneously increased.

To the subject of palpitations of the heart we shall afterwards recur, when it will be seen that in the great majority of instances they are of a nervous or sympathetic origin, and altogether independent of organic disease.

The *irregularity of the heart's rhythm* has regard to the relative duration of the first and second sounds, and also to the occasional recurrence of the first sound within less than the regular or equable time. Such irregularity may exist with or without palpitation; that is as we have seen, with or without a conscious-

ness of the heart's motions. An occasional ventricular contraction may be shorter and weaker than the adjoining ones, in consequence of which the period of silence will be longer, and the idea of intermittence erroneously suggested, the whole time of the beat or complete revolution of the heart not being really greater than usual. This was thought by Laennec to occur mostly in cases of dilatation. On the other hand, a ventricular contraction may here and there be much longer than ordinary, so that the first sound entirely obscures the second: this is met with as a permanent phenomenon chiefly in cases of considerable hypertrophy in which the systolic sound, though dull, is commonly long drawn out. Finally, there may be a premature reiteration, or a reduplication, of the ventricular contraction, by which likewise the second sound may be masked. Here, if the second wave thrown out from the heart be large enough, we shall have a dicrotous pulse, otherwise there will be an intermittence in the arterial pulse as compared with the pulse at the heart. Such cases are supposed by Bouillaud frequently to depend on narrowing of the orifices, or on valvular disease preventing the speedy filling of the ventricles, which cavities consequently contracting on an inadequate supply are immediately obliged to repeat their action in order to complete their task.

The second sound has occasionally appeared to commence, as it were, prematurely, cutting short and obscuring the first; and in some very rare instances Laennec thought he had heard the second sound twice or thrice reiterated with great rapidity. Now though his theory of this sound, and consequently his explanation of these cases, were incorrect, yet the facts themselves, having been recorded by an observer of such acknowledged accuracy, are not lightly to be passed over or discredited. As he has added, in regard to the latter class of cases, that they occurred in every instance in connexion with ventricular hypertrophy, it is possible that the sounds heard may have been but the reduplication of the first sound already alluded to. A repetition of abortive ventricular contractions might readily give rise to such a mistake as he committed in their explanation, especially when the jets of blood propelled from the heart were too inconsiderable to produce corresponding pulsations at the wrist. If reiterations of the second sound ever really take place, we see no other way of accounting for them but to suppose them to depend on the diastole of the ventricles, and that this is effected convulsively, or by a succession of partial or incomplete movements: now this would imply, obviously, either a power of active muscular expansion in these cavities, the possibility of which, though not yet satisfactorily made out, we are not prepared altogether to deny; or else a graduated or intermittent yielding of the contracted muscle to the force of elasticity.

In contrast with the various cases mentioned above, there is another class in which the natural double sound of the heart seems altogether absorbed in a single prolonged bellows-murmur. Yet even here, sometimes, a division can be effected, as Bouillaud has remarked, and the murmur answering to the second sound made to appear distinct from that appertaining to the first, by reducing the frequency of the pulse by digitalis or other means; or occasionally by merely removing the stethoscope to some distance from the point where the blowing sound is most intense. In cases of extreme debility, however, the second sound is entirely and in all situations inaudible, as we have already seen.

Intermittence of the heart-pulse. As the term *irregularity* has regard to the *actions* of the heart in respect to their being prolonged, shortened, interfering, or anticipating; so, *intermittence* refers to an occasional prolongation of the period of repose or silence beyond the regular or equable time. Here, though the first and second sounds may retain their due relation in respect to strength and duration, the rhythm is, notwithstanding, broken through. The interruption may be equal to, superior, or less than, the ordinary period of a complete revolution of the heart. The intermittence of the pulse at the wrist is, however, no proof of intermission at the heart, as it may depend merely on an occasional feebleness of the systole, some of the ventricular contractions being performed with too little energy to make themselves perceptible in the remote arteries. Hence the distinction into true and

false intermissions. The latter, as well as the former, are very common in old people, ceasing, in some cases, on the supervention of slight illnesses, especially of an inflammatory kind; whilst in others, on the contrary, it is only under such circumstances that they make their appearance. In persons in the vigour of life, their occurrence, more especially during palpitations, was considered by Laennec almost as decisive proof of the existence of disease of the heart, and more especially of hypertrophy of the ventricles. Our own experience has not led us to acquiesce in the justness of this observation, having met with numerous instances of intermitting pulse in young persons without any reason to believe in the presence of organic disease.

The arterial pulse. Into this intricate subject we cannot afford space to enter fully, and must therefore confine ourselves to the notice of a few points of peculiar interest in regard to it.

The pulse, which is only incidentally mentioned by Hippocrates, who seems rarely to have drawn his indications from it, had its importance first duly appreciated by Herophilus. His opinion as to its practical value does not, however, appear to have been universally adopted by the ancients, for Celsus speaks very slightly of it, as liable to so many sources of error, in respect to age, sex, idiosyncrasy, &c., as to render it of little avail as a means of distinguishing disease or directing its treatment. To Galen, who made it a subject of peculiar study, and who enlarged to an extravagant degree on its value and niceties in several express dissertations, may perhaps be traced the unmeasured confidence which has been bestowed very generally on the pulse as a ground of diagnosis, prognosis, and management of disease down to our own day. The Chinese have even outdone the nations of Europe in regard to the attention bestowed on the pulse, believing that by it we may not only detect the presence and nature of a disorder, but also decide in which of the great cavities, and on which side of the body, it is situated. Harvey's discovery of the circulation, whilst it gave no support to such extravagant pretensions, fixed the real value of this sign on a firmer basis than ever. The invention of the pulse-watch by Sir John Floyer first enabled physicians to indicate, with accuracy, the degree of frequency of the circulation.* Various futile or fanciful distinctions in the pulse were subsequently attempted to be established by Solano, Fouquet, and Borden, but they never seem to have attained to much credit in this country. Drs. Heberden and Falconer, two of our principal writers on the subject, fell, indeed, into the opposite extreme of confining attention almost exclusively to the frequency of the pulsations, as if this were the only circumstance respecting which we can form a determinate notion, or at least the only one as to which we can feel certain of its being appreciated exactly alike by different individuals. The investigations of Laennec have proved satisfactorily that this view is too limited; and shown, at the same time, that much valuable information may be obtained by comparing the pulse as felt at the heart with its condition in the more distant arterial branches. The attempted distinctions of Stahl between the quick or short and the frequent pulse, and between the slow or prolonged and the rare pulse, are now known to be well founded, though opposed originally by the high authority of Hoffmann. The frequency and rareness of the pulse depend on

* The natural pulse of the adult male, in a state of health, may be stated as varying between 60 and 70 pulsations in the minute; that of the female on an average being about ten beats higher. In disease, the deviation from the healthy standard is often very remarkable: thus, M. Piorry has observed so few as 17 beats in a minute; and we have, on the other hand, distinctly counted as many as 200 beats in one stage of a case of acute hydrocephalus; and Frank a similar number in a case of inflammation of the great arteries near the heart of an adult. We have read moreover of instances where a still greater number of pulsations was noted within the same space of time. Dr. Graves speaks of the singular case of a lady, whose pulse, which was only 38 in a minute, did not become accelerated during febrile illnesses —

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the number of complete revolutions performed by the heart in a given time;—its quickness and slowness on the time occupied in each ventricular contraction, if we refer to the heart; but partly also on the tone of the arteries, as indicated by the degree of their yielding, and the speed with which they react on the blood injected into them, if we refer to the pulse in the remoter parts of the system.

The state of the pulsations at the heart was justly held by Laennec as constituting a better index of the degree of danger in a disease, as well as of the appropriateness of depletion, and of the length to which it may be carried, than the arterial pulse. In diseases of the heart, for example, the latter may be very feeble, whilst the former by its violence justifies the use of the lancet. It was a rule with him that we may bleed fearlessly, however weak the pulse at the wrist, provided the contraction of the ventricles be energetic; whereas, if the heart's action, on the contrary, be feeble, whatever is the state of the arterial pulse we must abstain from the use of this remedy. The doctrine of the arterial and capillary action being to a considerable degree independent of that of the heart, which has latterly met with many able advocates, was the fixed creed of Laennec, who thought it was in a manner proved by the very different effects of venous, arterial, and capillary depletions. The insulated occurrence of the bellows-murmur and purring thrill in arteries was likewise adduced amongst the evidence of this independent action.

The character of the arterial pulse depends, as Dr. Williams remarks, jointly on the mode of action of the heart, on the quantity of blood in the system, and on the state of the arteries themselves; and necessarily varies with changes in each of these elements. (*Med. Gaz.*) The number of pulsations at the wrist can obviously never exceed that at the heart, but may, as we have seen, sometimes fall much short thereof, viz., where some of the ventricular contractions are so weak and incomplete that the impulse given by them to the blood is lost long before reaching the more distant arteries. Again, when the action of the heart is greatly reduced, as in the state of syncope, the radial pulse may, for a time, be even entirely extinct. In violent palpitations, moreover, the arterial pulse may be quite feeble, and indicate that the action of the heart, though so vehement and tumultuous, is really inefficient. Hence the obvious importance of exploring the pulse simultaneously in the two situations indicated, in order to obtain a correct idea of the real state of the circulation as a whole.

That the character of the pulse is in a conspicuous degree dependent on the mode of action of the central organ of the circulation we have proof in its becoming sharp when the contractions of the heart are abrupt, as happens especially in states of nervous irritation, or in febrile conditions when complicated therewith. In active inflammation it commonly possesses, in addition to sharpness, a marked degree of strength. Organic affections of the heart are, as we should expect, peculiarly capable of influencing the pulse. Active enlargement of the organ, when unaccompanied by any very great obstruction of the orifices or inadequacy of the valves, generally gives rise to a full pulse, which will be hard in proportion to the tension of the coats of the arteries. If the heart, on the other hand, be dilated, and its walls thinner than natural, the pulse may be abrupt or sharp, but not strong, and is generally slow of reaching the distant arteries. Its size will vary with the state of the arteries and the quantity of blood. Inefficiency of the mitral valves, admitting of regurgitation, tends to deprive the pulse, which is in such cases generally very irregular, of part of its fulness and strength. Imperfect aortic valves, from the same cause, give a jerking or momentary character to the impression of the pulse against the finger, and at the same time render the onward motion of the arterial wave, as has been remarked by Dr. Corrigan, peculiarly visible; for the column of blood, though often expelled with great force, in consequence of the frequently co-existing hypertrophy, is yet, from the inadequacy of the valves, not sustained during the natural period, so that a portion of it almost instantly falls back into the ventricle, and thus effaces in a moment the dilated tortuosity of the vessel. In cases of narrowing

of the left auriculo-ventricular orifice, the pulse is for the most part not only small, but peculiarly irregular, and it is in this form of disease that we have very often, as pointed out by Mr. Hodgson, two beats at the heart for one at the wrist; both of which circumstances are ascribable to the imperfect supply of the left ventricle with blood. Narrowing of the aortic orifice, if considerable, must necessarily diminish the force of the pulse, but, unless existing in an extreme degree, it may still be possessed of much hardness. (Williams, *loc. cit.*)

Of the influence of the quantity of blood on the pulse, we have a striking example in cases of plethora, in which it is distinguished by its fulness as well as strength, unless where, from over-distention or some other cause, the action of the heart is temporarily oppressed; and, even here, blood-letting will often immediately lead to the development of its true character. Again, loss of blood in ordinary cases renders the pulse softer and less frequent; but if carried to excess, or performed in particular states of the system, such as exist in nervous or chlorotic individuals, it seems to exalt the irritability of the heart, and consequently renders the pulse more rapid and sharper; but even then it will have a quick jerking or bounding character, without fulness or permanency under the finger, sufficiently indicative of deficiency of blood in the vessels and abrupt systole of the heart.

The state of the arteries, in respect to tone and elasticity and thickness of parietes, necessarily exercises a considerable influence on the pulse. When they are large and yielding, supposing the heart to be acting with its ordinary rigour, the pulse will be full and soft. When, on the contrary, they are contracted and tense, it must be hard and small. The tone of the arteries, or their contractility, is notably modified by temperature and hygrometricity, being augmented by a cool dry atmosphere, and diminished by the opposite conditions. Where the coats of the arteries, as in the aged, are rigid, the impulse given to the blood by the heart will be transmitted with little modification; whereas, if the arteries are thin, elastic, and imperfectly distended, they must tend to reduce its hardness and force, and retard its progress, and, if any of the pulsations be particularly weak, to obliterate them altogether. In inflammatory conditions of the system, in consequence of the increased tension of the arteries, the pulse in the extremities is almost synchronous with that in the heart; whilst in debilitated states, on the contrary, in which the vessels paricipitate, the transmission through the relaxed arterial tubes is much slower, and consequently the interval between the pulse in the two situations just indicated is remarkably augmented. The state of the capillary circulation is likewise to be taken into account amongst the circumstances capable of modifying the arterial pulse. An artery running to an inflamed part throbs with unusual vehemence, and seems to participate with its ultimate ramifications in a state of exalted action. The condition of the veins and capillaries often, moreover, throw much light on the state of the general and pulmonary circulation, and should always be carefully investigated. A swollen state of the venous trunks, and pulsation in the jugular, frequently point unequivocally to over-distention of the right side of the heart, and imperfect action of the tricuspid valves; whilst a general overloading of the capillaries with arterial or with venous blood, which displays itself so peculiarly in the cheeks, conjunctiva, lips, and extremities, is likewise indicative of various states or stages of deranged or obstructed circulation, and remarkably characteristic of disease of the organs within the chest, and most particularly so of organic affections of the heart.

The condition of the lungs, placed as they are between the right and left sides of the heart, very materially influences the pulse. The numerical relation between the pulse and the number of respirations in a given time may be stated in the healthy condition to be about as $4\frac{1}{2}$ to 1. Dr. Hooker, in an interesting communication in a recent number of the *Boston Medical and Surgical Journal*, says that this is so universally true, that any great deviation from it may be looked upon as evidence of mal-formation or disease, provided there be no mechanical impediment within

or without the body to the descent of the diaphragm. Where the rate of the respiration to the pulse is notably increased, it generally indicates some impediment to the aëration of the blood, either from disorder in the air-passages or lungs (pneumonia, œdema of the lungs, incipient phthisis, &c.,) mechanical impediment, or imperfect function, of the organic nerves of the lung. In typhus and delirium tremens, on the contrary, the relative frequency of the respiration is remarkably diminished, which may be ascribed to the disordered condition of the brain and spinal cord, and impaired function of the motor respiratory nerves. The relation of the breathing to the pulse has also engaged the attention of Dr. Macdonnell, of Belfast, for many years; but it is to be regretted that the result of his investigations, which were carried on, on a very extended scale, have not yet been communicated to the public in a complete form. Some notice of them is to be met with in the reports of the medical section of the British Association for the year 1835.

The obstruction of the lungs, as in severe and very extensive cases of pneumonia and bronchitis, and of profuse pleuritic effusion, necessarily causes an overloading of the right cavities; whilst those of the left side are inadequately supplied with an imperfectly arterialized blood, and consequently contract for the most part with diminished energy; under these circumstances the pulse, notwithstanding the presence of inflammation, will be comparatively soft and feeble, though it may occasionally have a certain degree of abruptness or sharpness about it which might by the inexperienced be mistaken for strength. It is accordingly a very general rule, that when the respiration is profoundly impaired the pulse soon loses its body and strength. (*Williams.*) There is a peculiar state of the pulse, mentioned by Laennec, in which it remains for some time tense and full under the finger, and which seems, occasionally at least, to be produced by obstruction of the pulmonary circulation, for it is felt in a very marked manner during a fit of coughing, and may possibly also be sometimes caused by a spasmodic continuance of the ventricular systole leading to an overloaded condition of the auricles, and consequently to momentary obstruction in the capillaries, and an interruption to the onward movement of the arterial current.

To prepare us for forming a just estimate of what constitutes in any given case a morbid condition of the pulse, we must be aware of the varieties to be found in the natural state,—varieties dependent partly on the strength of the heart, and partly on the natural constitution of the arteries. Thus persons in whom the arteries have thin and yielding coats, and are at the same time of large diameter, will (the action of the heart being moderate) ordinarily have a soft large pulse; if their caliber be small, as is frequently the case in females, the pulse will be small and weak; if the walls on the other hand, be deficient in elasticity and very firm, as in the aged, the pulse will then commonly be hard and strong, as well in health as in disease,—a circumstance which often takes greatly from the value of this sign as indicative of inflammatory action, or particular diseases of the heart, in advanced life.

The pulse is influenced not only by diseases, temperature, age, sex, temperament, and idiosyncrasy, but also, and very remarkably, by moral emotions, by diet, by the recent taking of food or other stimuli, by inanition, by narcotics, by exercise, posture, sleep, and watching, and the period of the day, &c. Gravitation manifests a decided influence on the pulse; thus, for instance, as M. Piorry remarks, if a limb be raised into a vertical position, the beat of the artery becomes considerably feebler. Bryan Robinson, in his treatise on the Animal Economy, shows himself to have been fully aware of the effect of gravity on the motion of the blood in the vessels. The influence of exercise in raising the pulse exceeds greatly that of all other stimuli, and even of the most inflammatory fevers. (*Knox.*) A full meal will augment the frequency of the pulsations of the heart by from ten to twenty beats in the minute, according to the excitability of the individual. The ordinary ratio of the pulse to the respiration in healthy adults is, as we have seen, as a little more than four to one; and variations in this relation afford valu-

able indications in disease.* The frequency of both functions is considerably reduced during sleep, which seems to depend chiefly on the comparative cessation of all voluntary muscular action.

The *effects of posture* on the pulse, for the knowledge of which we are indebted originally to Dr. Bryan Robinson in the work already alluded to, and more recently to the investigations of Drs. Macdonnell, Falconer, Knox, Graves, Nick, Mohl, Guy, &c., are very remarkable. The pulse is, for the most part, considerably more frequent in the erect or standing than in the sitting posture; and in this latter, again, somewhat quicker than when lying; the average difference in the first instance being about double of that in the second. Thus, in Dr. Guy's experiments, after the deduction of all exceptional cases, the average difference between the standing and sitting posture, the heart beating moderately, was about ten pulsations; between sitting and lying, about five; and between standing and lying, about fifteen. The difference depends on, and is directly proportional to, the muscular effort exerted in the maintenance of the respective postures. It becomes greatly augmented in cases of debility and fever; and increases in a very rapid ratio whenever the circulation, whether from disease or exercise, is much accelerated. It is, moreover, according to Dr. Knox, most conspicuous in the earlier parts of the day, reaching its maximum about noon, and its minimum towards midnight. The excitability of the pulse in respect to other causes is likewise, when in a state of health, at its height in the morning. Every one of susceptible nerves must have observed how very small a quantity of wine or animal food is sufficient to overheat and flush him at that time of day.

The strength of the pulse is greatest in the recumbent posture, so that the greatest strength and least frequency are attained simultaneously. Inverting the body, as Dr. Graves remarks, renders the pulse occasionally irregular, and weaker than when in the horizontal posture; but he did not find it farther to retard it. On this latter point, however, his observations are at variance with those very recently made by Dr. Guy, in which the pulse fell on an average three beats (and in particular cases much more than this,) on the body being sustained in a vertical position by means of a revolving board to which it was strapped. The writer last named has farther noticed that the influence of posture is somewhat greater in the male than in the female; and in adult age than at a more youthful period.

To all the above rules, as to the effect of position, there occur many exceptions the causes of which have not as yet been fully explained. In some cases of disease of the organs within the chest, where the recumbent posture still farther embarrasses their action, we should expect to find them often infringed upon, or even reversed: so likewise, sometimes, where tumours or effusions within the abdomen are brought to gravitate more than usual on the thoracic contents. In advanced cases of hypertrophy and dilatation of the heart, Dr. Graves has found the pulse very generally unaffected by posture; and he suggests that where this exemption exists it might perhaps be ascribable to the increased power of the muscle placing it beyond the influence of the ordinary causes of excitement, which, as we have seen, are most conspicuous in weaker conditions: and thus we attain to another criterion by which to distinguish organic from functional disease of the heart.†

Mr. Gorham's tables of the pulse in infancy and childhood show, in conformity with the results attained by Dr. Guy, that the effect of posture is much less con-

* Dr. Graves once met with a case of fever in which, though the pulse was but 60, the respirations were 50, in the minute; in another case, the pulse being 84, the respirations were 42; in a third, the pulse being 120, the respirations were no more than 12: and he has made the general remark, that where the respirations are very numerous (40, for example,) with a comparatively low pulse (80 to 90) a fatal result may generally be anticipated.—AUTHOR.

† Dr. Graves's latest investigations on this subject led him to consider the law of exemption, under such circumstances, universal.—AUTHOR.

spicuous in young subjects than at a more advanced period. In infants in arms, who in every posture are chiefly dependent on external support, and make comparatively little muscular exertion to maintain their position, this is just what we should expect. In childhood, again, the mass of the heart bears a much greater proportion to that of the whole body than at a later age, and may therefore be supposed more independent of the influence of slight modifying causes, and better adapted by nature for the restless movement and constant change of posture characteristic of that age. Mr. Gorham's observations demonstrate the curious fact that the mean pulse of the new-born infant is considerably less than that of a child some weeks or months old; the average pulse during the first week being about 128; that between the first and fifth month about 148; from the fifth month to two years old, which includes the period of dentition, the pulse still keeps high, the mean being about 130; that from the second to the fourth year about 112, and from thence to the tenth about 107. The maxima and minima are, however, often very remote indeed from the mean results: thus, during the first week of infancy, out of forty-two observations, the maximum was 160, and the minimum so low as 96. The mean numbers are throughout much higher than the corresponding ones given by Heberden; but as the latter author does not mention the number of cases from which his averages were deduced, and seems even to have overlooked the fact of the rise of the pulse subsequent to birth, his results appear less entitled to credit than those of Mr. Gorham. The subject is still, however, open to farther investigation.

Venous pulse. It has recently been asserted by Mr. King (*Guy's Hospital Reports*) that by means of a sphygmometer, consisting of a fine capillary index, made by drawing out a piece of sealing-wax into a thread, and affixed by a little tallow across a superficial vein, so that about nine-tenths of its length may project on one side of the vessel, the phenomenon of a venous pulse may, in all cases, be rendered obvious to the sight; but most satisfactorily so when repletion of the sanguineous system exists. The attempt to verify this observation has, however, to our knowledge, totally failed in other and very careful hands; so that it appears still very doubtful whether, in the natural condition, there is any appreciable pulsation in these vessels, save such as may occasionally be communicated to them by an immediately subjacent artery. Yet, in certain morbid states of the circulation, an independent venous pulse has unquestionably been observed; though, with the exception of the throbbing of the jugulars in disease of the right side of the heart, already alluded to, it has not yet been made out distinctly what is the precise morbid condition of the circulatory system with which it is more peculiarly associated. The cases, however, in which it has chiefly occurred have generally been those in which there was præternatural vehemence of the heart's action, either connected with disease in this organ itself, obstruction of the pulmonary circulation, violent inflammation in some important viscus, or, finally, with the irritative reaction ensuing upon excessive depletions;—and it has been variously ascribed to over-action of the left ventricle, and the forcible transmission of the wave-like motion of the blood through the capillary system; to regurgitation from the right ventricle, and a retrograde impulse communicated through the substance of the valves of the tensely distended veins; and, lastly, to an independent action in these vessels themselves. It has most frequently been noticed in the upper extremities and generally in females.

In the instance recorded by Hombert (*Mém. de l'Acad. des Sciences*, Paris, 1704,) the venous pulsation, which is stated not to have been synchronous with the action of the arteries, occurred in the paroxysms of asthma, in a case of passive dilatation of all the cavities of the heart, and was supposed to depend on regurgitation taking place during the existence of violent palpitation. Dr. Davis met with the same phenomenon in a patient, in whom dissection is said to have discovered nothing but a slight degree of hypertrophy of the left ventricle. (*Dub. Hosp. Rep.* vol. iv.) Dr. Elliotson, in a note to Blumenbach's *Physiology*, speaks of having seen the veins on the back of the arm and the forearm pulsate

in unison with the arteries, in a young female labouring under a chronic catarrh, in which the paroxysms of coughing were very violent. The same appearance has been noticed by Dr. Ward, in the same situation, in a woman who was much debilitated by a miscarriage, and subsequently by large depletions on account of an incipient pneumonia; and he supposed the pulsation in question to have depended "on excessive reaction of the heart, pushing the thin and impoverished blood through the capillary system straight on into the veins." (*Lond. Med. Gaz.*, June, 1832.) A distinct pulsation corresponding to each stroke of the left ventricle was observed by Dr. Graves in all the veins on the back of the hand in a case of pneumonia, in which the action of the heart was peculiarly vehement; and also in a female labouring under acute peritonitis. He was unable to decide whether the phenomenon originated under the direct influence of the heart, or in an independent action in the coats of the veins themselves. (*Ibid.* Jan. 1831; and also in *Dub. Med. Journ.*, Sept. 1834.)

A more detailed account of a case of the same kind, which appears to have been examined with great care both during life and after death, is given by Mr. Benson in the *Dublin Medical Journal*, for Nov. 1835, to whose able paper on the subject, we are indebted for most of the above facts. The patient who had long laboured under symptoms of enlargement of the heart, was a female of intemperate habits and advanced age; and the pulsation was confined to the jugulars and to the veins of the upper extremities, which were remarkably tense and prominent; and it followed, by a minute but distinctly appreciable interval, the diastole of the radial artery. Though the arterial pulse was very feeble, that in the veins was quite obvious to the sight; and some individuals who examined the patient thought they could also feel it. It was ascertained that the valves of the veins acted perfectly, and that the pulsation was interrupted when pressure was made on the brachial artery; and also that it disappeared temporarily after practising depletion. On dissection, the heart was found of double the natural size, chiefly owing to the greatly dilated and hypertrophic condition of the right ventricle; the orifice of communication with the auricle was much enlarged, and the corresponding valve in part cartilaginous. The mitral and aortic valves were encrusted with calcareous matter, and the left passages thus very considerably narrowed; whilst the ventricle of this side, though enlarged, was apparently not increased in power, its walls being pale and soft. Nothing peculiar could be detected in the vessels of the arm, and there was certainly no unnatural dilatation of the capillaries, as it was attempted in vain to force a fine injection from the arteries into the veins. Mr. Benson ascribes the unusual pulsation in this case, with much probability, to regurgitations from the right ventricle, a retrograde shock being thus communicated to the column of fluid in the distended veins, by the very violence with which their valves were thrown up; whilst the circumstance of its succeeding, by an appreciable interval, the pulse in the arteries, is attributed to the more yielding nature of the structure of the former vessels. The obstructed condition of the orifices of the left side of the heart, and the consequent weakness of the pulse, certainly render it unlikely that the venous pulsation should have been continued through the capillary system; whilst the influence of pressure on the great artery of the limb, already noticed, may have depended on the diminished tension of all the veins so caused, and the consequent neutralization of the reflex impulse.

GENERAL OBSERVATIONS ON DISEASES OF THE HEART.

The term "disease of the heart" stood in times past, with many members of the medical profession, as it does still with the public, for a uniform and general affection of this organ, of an utterly intractable and necessarily fatal nature. More accurate investigation into the symptoms and progress, and still more into the morbid changes of structure, presenting themselves in the individual cases passing under this title, has eventually proved how erroneous is the above conception

in all its parts. Disease of the whole heart is scarcely ever met with. As there enter into the composition of this organ examples of most of the tissues which are to be found within the body, and as its mechanism is of a complicated nature, it offers, like other parts of high and varied organization and energetic action, many points for the origination of disease. This generally manifests itself first within the limits of a single tissue, more commonly the inner or outer lining of the organ, or its muscular walls; and even when it comes at length to alter the size and form of the organ, the relations of its cavities, the orifices of communication and the valves which surround them, these parts are still found to be affected in very different degrees. The right and the left sides, too, are very rarely compromised to the same extent, and even the two cavities of the same side scarcely ever suffer equally.

Some of the most violent, painful, and, if unchecked, often most rapidly fatal, diseases of the heart are, as we shall afterwards see, of an inflammatory nature. These, when neglected or imperfectly subdued, if not fatal in their earlier periods, generally give rise to such organic changes as are comparatively little within any other than the palliative influences of medicine. Some of its affections, again, often apparently originating in a very chronic species of inflammation, come on insidiously from the first in the form of a gradual deposition of morbid matter, generally of a cartilaginous or osseous nature, occupying more especially the apertures of communication, and the most moveable and delicate portions of the interior mechanism, which, by throwing obstruction in the way of the blood, and compelling the organ to increased exertion, lead to morbid development of the muscular tissue, to distention of its cavities, or more frequently to both. In other instances, similar changes of dimensions seem to ensue merely upon excessive action and consequent over-nutrition of the organ, often evidently the result of habitual undue excitement of a moral or physical nature. An opposite class of cases, of rarer occurrence, are characterized by a wasting away or softening of the heart, a loss of size and power, which seem for the most part to have their source in general or constitutional causes. In a very large number of instances, again, the deranged action is happily merely of a functional nature, depending on a peculiar condition of the nerves of the organ, or that of the system at large; or, it may be, on the reaction of some of the other viscera; and it is here, under favourable circumstances and judicious management, for the most part susceptible of great alleviation or complete removal.

From these general views, the importance of accurately discriminating the various disorders to which the heart is liable will, we trust, sufficiently appear. The means by which their diagnosis from each other, as well as from diseases of other organs, is to be attempted, are of two kinds. 1st, the local or physical signs; 2d, the general symptoms. The local signs fall under the cognizance of one or other of the three senses of sight, touch, or hearing, and more especially of the last two. By accurately inspecting the præcordial region, we may become acquainted with enlargements and changes of form in this part of the chest, depending on considerable effusion into the pericardium, or great augmentation in the size of the heart; and are likewise sometimes made aware of the existence of vehement cardiac action by the visible heaving of the corresponding parietes, and the shaking of the vestments, at every pulsation. A dimpling or depression of the epigastrium, coincident with the contraction of the heart, has been asserted to be sometimes obvious to the eye, and has been reckoned amongst the occasional, though rarer, signs of a closely adherent pericardium.

By the touch we learn whether the impulse of the heart takes place in the natural situation, or whether it is felt in a different point, or over a larger surface, than usual; whether it is increased in frequency, force, or duration; whether it is accompanied by a jarring or thrilling sensation; and finally whether there is any bulging or unnatural increase of width in the intercostal spaces. By the employment of pressure between the ribs, or in the epigastrium in an upward direction towards the tendinous part of the diaphragm, to which, as we have seen, the pericardium

is attached, and on which the heart lies, we become cognizant of any unnatural tenderness either in this membrane, or in the important organ which it protects, both of which are, in the natural condition, nearly insensible, as was proved by Harvey's celebrated case where the heart was exposed to the touch.

By *auscultation* we ascertain whether the normal sounds accompanying the heart's action have undergone any of those changes, in respect to their character, place, or intensity, which have been already spoken of, and so obtain valuable knowledge as to the state of its walls and cavities, orifices, valves, and great vessels: whilst the sounds artificially elicited by percussion make known to us the presence of effusions into the pericardium, tumours and aneurisms in the same situation, or its immediate neighbourhood; as likewise the existence of inordinate congestion and enlargement of the heart.

The anxious, protruding, watery eye, the fulness of the under lid, the morbidly pale, leaden, or purplish hue of the complexion, give a peculiar and often very striking *physiognomy* to patients labouring under disease of the heart in its more advanced periods.

The *general signs* or symptoms of its disease are necessarily numerous and complicated, inasmuch as in the derangement of its function, viz. the due circulation of the blood to all parts of the body, every organ is more or less implicated. In this respect nearly all its serious lesions coincide; but, as we investigate more closely the groups of symptoms to which each variety of disease individually gives rise, we shall find in them very considerable shades of difference, according to the part of the organ affected, the stage or degree of the structural change and its precise nature. Thus, where the inner or outer covering is inflamed, there will commonly exist, as in the case of inflammation of similar membranes in other parts of the body, acute pain and fever, exasperated more particularly in this instance by the impossibility of placing the suffering organ in a state of permanent repose;—together with alarming nervous symptoms, originating in part in the sympathy of the brain with the important viscus engaged, as well as in occasional disorder in the sanguineous supply of the cerebral system.

Increased size and power of the left ventricle will prove the source of frequent active determinations of blood, especially towards the head, as indicated by the florid or flushed condition of the face, the brightness of the eyes, and animated expression of the whole countenance, and irascibility of temper; whilst there is besides, in such cases, often a sense of dizziness and confusion, especially in stooping, occasional profuse bleeding from the nose, and a marked tendency to cerebral hæmorrhage.

In the rarer instance of a similar condition of the right ventricle, the lungs suffer more particularly, or at least earlier in the course of the disease, as is evinced by the frequent occurrence of hæmoptysis, pulmonary apoplexy, &c.

Pulmonic congestions, however, and inflammations, more especially those having their seat in the bronchial membrane, and passing under the vague title of asthmatic affections, occur, it must be confessed, sooner or later, in nearly all diseases of the heart, in whatever part of the organ they may have originated.

It is when there exists a considerable mechanical obstruction to the passage of the blood on either side of the heart, and also when the action of the organ is greatly debilitated, that the disturbance of the circulation reaches its maximum, as manifested in the extremely deranged action of the capillary system, the obstinate recurrence of venous congestions, and passive serous effusions. Where the impediment is in the left side, the lung will probably be the seat of the earliest obvious functional disturbance; whereas, if it be in the right cavities, the venous system of the abdomen and head will be more apt to participate in its effects from the first: but to state this order of the occurrence of symptoms as absolutely fixed and essentially characteristic of affection of each side respectively, as has occasionally been done, would only tend to mislead, because inconsistent with actual experience. MM. Bertin and Bouillaud, without denying altogether the influence of hypertrophy, dilatation, and softening of the heart in embarrassing the circulation,

obviously consider its derangements as chiefly the result of mechanical obstacle. Dr. Hope, on the contrary, thinks the former conditions even more deeply concerned in their production than the latter; and Dr. Clendinning in his recent publications takes a still lower view of the importance of mere mechanical obstruction in respect to the visceral derangements induced by cardiac disease; for it would appear by them that out of about 180 cases of hypertrophy of the heart, no less than $\frac{5}{6}$ of the whole number were instances of simple hypertrophy, being, as he assures us, quite exempt from all other pathological change in the organ; its valves, orifices, linings, &c., being found altogether in their natural condition. He adds, that cerebral apoplexy had occurred in no less than forty-two per cent. or $\frac{2}{3}$ of these cases; and that in almost every instance there was visceral disease of some kind or other, in connexion with the simply enlarged heart. But he admits at the same time it is where disease of the orifices or of the valves is also present, that the most extensive dropsical effusions and the greatest pectoral distress manifest themselves. He insists, however, that the valvular disease is rather the consequence than the cause of hypertrophy, as this latter condition of the heart, itself the result of a vital and not of any mechanical condition, is known to predispose to inflammation of all parts of the body, and to that of its own inner lining membrane of course amongst the number.

On a review of the whole evidence, however, it appears to us that Dr. Clendinning decidedly underrates the influence of obstruction as an early element in the production of enlargement of the heart; and his conclusions on this point, standing as they do in opposition to those of some of the best observers of our day, require, we think, additional confirmation based on still more extensive premises.

A mode of an obviously mechanical nature, in which an enlarged heart or distended pericardium may sometimes derange the functions of an adjacent organ, is exemplified in the compression or displacement of the lung, or the flattening of some of the bronchial tubes, the latter of which consequences has recently been enlarged upon by Mr. King.

Amongst the occasional immediate consequences of disease of the heart have been enumerated, but on very insufficient evidence, a deep-seated destructive inflammation of the eye-ball, and gangrene of the limbs, to the latter of which we shall again have occasion to allude when we come to speak of hypertrophy. But, of all the consequences of diseased heart, none appear to be more constant than hypertrophy of all the organs within the three great visceral cavities. By the researches of Dr. Clendinning it has been established on the firm basis of the numerical method, that not only the liver, spleen, and lungs are notably increased in weight in such cases, but that this is the case likewise in respect to the brain, stomach, intestines, kidneys, pancreas, &c. Nor does this result appear to connect itself exclusively with any one particular disease of the heart, for it is met with in cases of extreme impediment to the course of the blood, no less than in those where the existence of hypertrophy and enlargement of the cavities, along with a free state of the orifices, might be thought to give an easy account of its origin. Dr. Clendinning thinks himself justified, therefore, in concluding that the several organs are able to convert even the venous blood with which they are congested into materials for their own excessive nutrition. That their increase is caused by a real augmentation of the solid parts, and not by mere congestion of the vessels, was ascertained by making incisions into their substance, and draining off as much of their fluid contents as possible, previously to submitting them to the balance.

Enlargements of the abdominal viscera, and more especially of the liver had long been observed frequently to co-exist with diseases of the heart, and were sometimes looked upon erroneously as their cause: whereas, they are really, for the most part but one instance of a general effect of this class of disorders. The flatulence, and other dyspeptic symptoms which so often manifest themselves in the advanced stage of cardiac affections, are, in like manner, generally the result of a secondary affection of the stomach. The kidneys, too, very commonly per-

form their function imperfectly, the urine being deficient in quantity, and high-coloured. But it is the respiratory system which most invariably suffers, as we might readily have anticipated from the close physiological connexion of the heart and lungs. Hydrothorax, asthma, and the chronic cough of the aged, so often mistaken in former times for primary affections, have, as is now well made out, most frequently their source in disease of the heart. How often the brain also is consecutively involved, we have just seen when speaking of the frequent occurrence of apoplexy in these cases. We have known headaches, of the most intense character, recurring at frequent intervals from a very early period of life, and rendering existence scarcely endurable, to have had the same origin, though their true source, at a period when diseases of the heart were less understood, and their physical signs less sought after than at present, had generally been quite overlooked by practitioners of the first eminence, by whom they had been treated throughout as if of nervous or of dyspeptic origin; till at length the occurrence of dropsical symptoms, and other signs of cardiac disease of a kind no longer to be mistaken, rendered their real nature obvious. Generally speaking, however, the symptomatic affection of the brain in these cases is of a less acutely painful character than that just spoken of.

Causes of Diseases of the Heart.

The almost unceasing labour of the heart, its extensive sympathies, and its consequent frequent excitement by affections of distant parts, enable us in some degree to understand why it should be so frequently the subject of disease. Corvisart believed that the number of deaths caused by diseases of the heart stood next in frequency to those produced by phthisis; and the results of Dr. Clendinning's numerical investigations are quite in harmony with this opinion: they show that what phthisis is, in point of frequency and mortality, prior to the middle period of life, disease of the heart becomes subsequently. Of all the dissections which he had occasion to witness within a given period, in the institution to which he is attached (amounting to upwards of 500,) about one-third presented evidence of the existence of disease of the heart, and more especially of hypertrophy; and of those so affected the males were twice as numerous as the females. Its presence is observed greatly to aggravate the danger of co-existing pulmonary, cerebral, or abdominal affections. From this circumstance, as well as from the frequency of its occurrence and its usual incurability in its advanced stages, the importance of accurately investigating its causes, in order to remove or counteract their influence, at the earliest period, is obvious. They are ordinarily divided into the predisposing, and the exciting,—a distinction, which here, however, as in so many other instances, cannot be universally adhered to, without the sacrifice of truth to the spirit of system, as several of their causes partake at once of both these characters.

That a hereditary tendency to heart disease exists in many individuals is unquestionable. Lancisi mentions one family in which it occurred in four successive generations; and Albertini another, in which five brothers with their sister were its victims; and numberless other instances to the same effect might, if necessary, be adduced. The rheumatic and the gouty, those who have laboured under very severe agues, persons of an irritable and of a sanguineous temperament, those of a plethoric habit, and likewise deep-chested individuals of a robust make, with an inordinate development of the muscular system, seem peculiarly prone to disease of the heart. At the head of the causes which are more immediately concerned in calling it into being, are to be placed all those favourable to the production of inflammation generally, and more especially exposure to cold and moisture; for the very same influences which give rise in one individual to a pleurisy, or a rheumatic attack, will in another be succeeded by the incursion of pericarditis or endocarditis, with all their formidable consequences. The co-

incidence also of inflammation of the lining membranes of the heart with pleurisy and pneumonia, and still more with acute rheumatism of the extremities is matter of daily observation; and instances of the metastasis of the latter affection, and of gout to the heart, abound. The repulsion of the exanthemata, and the mismanagement of the advanced stage of scarlatina, more particularly, are occasionally followed by inflammation of the serous covering of the heart, as well as of other similar tissues in other parts of the body. External injuries, as violent blows, or long-continued pressure on the præcordial region, and wounds, are also amongst the occasional diseases of the heart. Amongst their sources is also to be enumerated whatever produces frequent over-action of the organ, the abuse of stimulants, long-continued fatigue, loss of rest, sexual excesses, and a plethoric state, which is often connected with the suppression of some habitual evacuation, and with the hæmorrhoidal or menstrual fluxes more particularly.

Violent muscular efforts, also, and whatever materially embarrasses the pulmonary circulation, as the playing on certain wind instruments which require a great exertion of breath, and, finally, whatever makes excessive demands on the propulsive power of the heart, are to be placed in the same category. Although the disorder immediately ensuing upon exposure to such circumstances be at first only functional, all analogy leads us to expect, where they are habitually renewed, that structural change, if there exist any predisposition this way, should be their ultimate result.

Obstruction of the circulation, whether seated in the heart itself or in the great vessels, must necessarily, from the mutual connexion and dependence of the several parts of the system to which they belong, tend to produce additional disturbance and disease, enlargement of the cavities of the heart, hypertrophy of its walls, &c. The frequency of the coincidence of aneurism of the aorta with hypertrophy and dilatation of the heart has long attracted attention. An original disproportion of strength between the heart and the aorta is placed by Corvisart amongst the occasional causes of disease in either situation. Obstructions within the lung, as in chronic pneumonia, or bronchitis and asthma, are looked upon by the same author, as not unfrequent sources of heart disease. That they should be quite uninfluential in regard to it, is certainly altogether improbable; but in a very great majority of instances, it is much more likely that they are its effect than its cause, though, in their turn, they cannot fail to react injuriously on it.

As to the influence of the moral emotions, we are satisfied, notwithstanding the skepticism of M. Bouillaud, that Corvisart, Schina, and the great majority of writers who side with them, are quite justified in laying great stress on them as occasional causes not only of the nervous, but also of the organic affections of the heart, as the greater prevalence of these disorders after periods of vehement civil commotion (as was remarkably the case after the French revolution) sufficiently testify.

As to the asserted agency of the syphilitic or other virus in inducing morbid vegetation of the valves, no adequate proof, that we are aware of, has ever yet been adduced.

Derangement of the general health, induced by errors in diet, anxiety of mind, and neglect of air and exercise, will tend to accelerate the development of diseases of the heart no less than those of other organs.

Prognosis in diseases of the heart. Diseases of the heart are no longer considered of so uniformly hopeless a character as we find ascribed to them in the pages of the old writers, and even of Sénae and of Corvisart. An improved diagnosis, and a more correct knowledge of the varieties of these affections, enable the practitioner of the present day to discover them earlier, and treat more appropriately and vigorously than his predecessors such as are still within the reach of art.

In the merely nervous and symptomatic affections, the prognosis is generally favourable, especially where no marked debility has yet supervened, and where

the derangement of the primarily affected organs is ascertained to be of a tractable nature; and even those of an inflammatory or incipient structural character are no longer looked upon as desperate. Thus acute endocarditis and pericarditis, though very serious maladies, are, at least in their earlier stages, by no means of necessary or even usual fatality, if treated with judgment and vigour. Simple hypertrophy of the heart, especially where the size of the cavities is little altered, and their orifices little affected; slight thickening of the valves, when not carried to such a degree as to interfere with the passage of the blood, or to admit of a reflux; adhesions, and organized depositions on the surface of the pericardium, are not incompatible with a very considerable prolongation of life, or even with the attainment of old age, where the sufferer is placed in favourable circumstances, and adheres strictly to habits of temperance and self-control, and the modes of treatment hereafter to be detailed. Yet, even after all these deductions, the list of incurable affections of the heart is still, and will probably ever remain, peculiarly formidable, inasmuch as some of the structural changes to which it is liable are not only of a permanent and unmanageable nature in themselves, but are so situated as almost necessarily to induce morbid alteration of a constantly augmenting character in the adjacent portions of the organ; a result unhappily promoted by the obvious impossibility of placing it in a condition of repose. Of this nature are ossifications and vegetations on the valves, incapacitating them for the due fulfilment of their office; conspicuous narrowing of the orifices; and most instances of chronic inflammation of the pericardium, especially if attended with an abundant or purulent effusion. And, finally there are certain conditions of the organ which are in their very nature mortal, and that almost immediately; such as rupture or wounds of its parietes, extensive polypous concretions within its cavities, and inordinately prolonged syncope, more particularly when occurring in connexion with extensive organic disease.

General Principles of the Treatment of Cardiac Diseases.

The treatment varies so totally, according to the different kinds of disorder, that most of what we have to say on the subject must be reserved till we come to treat of the individual affections in detail. We may however here remark, that there is no class of diseases in which the necessity of early and decided practice is more obvious, and in which, consequently, the importance of a correct diagnosis to render such treatment applicable, or even safe, is more unquestionable. The mischief is too often of an irreparable nature, which ensues from mistaking an inflammatory affection of the heart for one of a merely functional or nervous character, and thus losing forever the period in which alone active antiphlogistic measures might suffice to control the morbid action, and to anticipate its fearful train of organic changes. Plentiful and rapidly repeated abstractions of blood, both general and local, constitute here our chief resource, and are to be practised both with a view to directly influencing the inflammatory action, and also, by quickly reducing the quantity of the circulating fluid, to diminish, as far as may be safely practicable, the distention and labour of the suffering organ; for to place it in a state of absolute quiescence is, as already remarked, unfortunately incompatible with the very nature of its functions. And next in importance comes unquestionably the rapid introduction of mercury into the system,—an agent of such well-known efficacy in controlling inflammatory action, preventing or limiting the effusion of coagulable lymph and serum, and promoting their absorption when already thrown out, that the neglect of its early employment in any severe case would be quite unpardonable. Its efficiency is commonly much heightened by combination with opium; and where the skin is dry and harsh, and the fever runs particularly high, by the addition of antimony; or, especially if the affection be of a rheumatic origin, by the simultaneous exhibition of colchicum. At a somewhat more advanced period, counter-irritation, as we shall hereafter see, affords inva-

luable aid; and where organic disease is established, and on the advance, this, along with the moderate use of mercury during periods of aggravation, forms perhaps our chief therapeutical resource.

If the dangerous consequences of overlooking inflammation where it exists be so conspicuous, on the other hand, the evil of confounding a functional or sympathetic derangement of the heart's action with one of inflammatory or organic origin, though generally not so immediate in its manifestation, nor so rapidly destructive of the chances of recovery, may yet lead, not only to an unnecessary aggravation of the patient's sufferings, but, especially in anæmic and feeble individuals, to a termination as surely, though not so quickly, fatal, provided the error be not discovered in time, and the ill effects of loss of blood and other lowering measures studiously counteracted by a tonic treatment and restorative regimen. In cases where symptomatic affection continues long to be mistaken for idiopathic or organic, the organ, whatever it may be, which is really in fault, and the neglected source of all the secondary disturbance, may all the while be running on into incurable disease.

Finally, where considerable organic mischief already exists, a perfect cure of the disease being out of our reach, it only remains to endeavour to palliate its symptoms, and prevent or retard its extension: and this, chiefly, by avoiding all the known exciting causes, reducing, principally by dietetic means, the action of the organ as low as is consistent with the health of the body generally, and enjoining a life of tranquillity, both moral and physical, together with the advantages of a mild pure atmosphere, and easy exercise, especially gestation. On the more strictly medical measures conspiring to the same desirable result, we shall defer entering at present, and content ourselves here with merely reminding our readers that cases of established organic disease require great discrimination and caution, in respect to the employment of depletions; and that instances of dilatation, with thinning of the parietes, of the heart in particular, bear large bleedings extremely ill; and also that the due regulation of the digestive organs, the promotion of all the natural secretions and excretions, and keeping the mass of the blood moderate in quantity, but without impoverishing its quality, are objects never to be lost sight of.

We next proceed to the investigation of the special diseases of the heart.

NERVOUS AFFECTIONS OF THE HEART.

SINCE organic affections of the viscera have begun to attract so large a share of attention, those derangements, where no obvious accompanying physical change can be detected, have often been passed over in comparative silence. The *neuroses* of the heart have thus been altogether neglected by Corvisart, and even by Laennec but too cursorily noticed; whilst Testa and many other authors have so mixed up their accounts of them with those of structural disease, that no very distinct impression as to their nature is left on the mind of the reader. Yet of the reality of their existence, and we should have thought of their importance, even the most superficial investigation affords decisive evidence. Examples of disordered action of the heart in its mildest form, so mild and passing as not to fall under the category of disease, are furnished by the momentary palpitations induced through the influence of strong mental emotions, or by violent exercise, or other temporary physical excitements. It is only where, from the extreme sensitiveness of the nervous system generally, and of the cardiac nerves in particular, the recurrence of such irregular action becomes very frequent or distressing, and takes place from unusually slight or imperceptible causes, that it comes under the notice of the physician.

Under nervous affections of the heart are comprehended,—1. *Palpitation*; 2. *Syncope*; 3. *Angina pectoris*; 4. *Neuralgia of the heart*.

NERVOUS PALPITATION.

Idiopathic and Sympathetic.—Causes.—Diagnosis.—Treatment.

PALPITATION is that peculiar condition of the heart's movements wherein they become disagreeably perceptible to the patient; and is usually, as we have seen, accompanied by irregularity, as well as by an increase of the force and frequency of the pulsations. Palpitations, where they take place without any change in this organ cognizable to our senses, are termed nervous or functional; and these may be either *idiopathic*, depending on exalted sensibility of the cardiac nerves, rendering them susceptible of undue excitement from circumstances which, in their ordinary condition, would have no such effect; or *sympathetic*, when produced by the reaction of disorder or disease in some other organ. There are two very opposite conditions of the system in which they are peculiarly apt to occur, namely, the plethoric and the anæmic; states which are in themselves alone often quite sufficient to cause derangement of the heart's action, and which, whenever they exist strongly marked, will greatly modify such derangement, whatever additional or immediately exciting cause it may have. That an excess of blood of a more than ordinarily stimulating quality, complicated, it may be, with over-activity of the capillary system, forcing this fluid too rapidly in upon the heart, should often lead to embarrassment of the organ, is only what we might expect. Nor, on the other hand, does it appear very surprising when there is a deficiency of this fluid, accompanied as it usually is by a notable deterioration in its composition, as well as by increased mobility of the nervous system, that the heart should, in this its altered condition in respect to excitability, chemical stimulus, and distention, often contract in an irregular or spasmodic manner. That the fact is so, whatever may be its true explanation, we have ample evidence in cases of anæmia induced by over-depletion or by deficient nutriment; in which the blood is not only diminished in quantity, but also impoverished in respect to its fibrin and colouring matter, or otherwise impaired in quality; as, likewise, in the allied instances of chlorosis and scurvy, in all of which palpitations are amongst the most ordinary symptoms.

The chief remaining predisposing causes of such palpitations, in addition to those just mentioned, are a nervous or irritable temperament, youth, and debility.

In respect to duration, violence, and frequency of recurrence, these palpitations are susceptible of innumerable varieties, being characterized by all the waywardness and uncertainty of nervous affections generally. Thus, they may last but for a few minutes, or persist for whole days almost uninterruptedly; they may recur only at distant intervals, or, on the contrary, several times within the twenty-four hours. The impulse of the heart is generally increased, as are likewise, and in a still more remarkable degree, its sounds which are often accompanied by a metallic ringing,* from the impulse of the organ against the parietes of the chest, and are frequently distinctly heard as well as felt by the patient himself. A bellows murmur is sometimes heard in the præcordial region, accompanying the first sound of the heart, and also in the arteries, in which it occasionally assumes

* Dr. Hope, as we have already seen, rejects this explanation, and ascribes the augmented intensity of sound to the vehemence of the valvular and muscular tension at the instant of the reaction of the contained blood against the contracting walls of the ventricles; the sound being, in certain cases, still farther re-enforced, towards its termination, by the tripping of the apex against the margin of the fifth rib.—AUTHOR.

the musical, moaning, or cooing character: the remitting humming tone, formerly described, is in many cases audible, though this latter, as already stated, has probably most frequently its seat in the veins; the periodic swell, when it exists, depending on the interrupted pressure of a subjacent artery at the moments of its successive pulsations, or, if very loud, on a simultaneous murmur in this latter vessel.* There is also throbbing of the arteries, the pulse being short and jerking, occasionally with a thrill, but without the strength or resistance of the inflammatory pulse; and the contractions of the heart are, in some rare instances, attended with pain. The respiration is frequently embarrassed, whilst flushing of the face, ringing in the ears, and other nervous symptoms commonly co-exist, with a sense of restless anxiety referred to the præcordial region, and sometimes a tendency to faintness and syncope. In chlorotic patients, palpitations which are, as we have seen, amongst the most common and distressing symptoms, are often accompanied by dyspnœa on slight exertion, as in going up stairs, for instance, and sometimes by œdematous swelling of the face and extremities. The derangement of the heart here assumes a good deal of the passive character, the palpitations being obviously the efforts of a weak organ, and producing sometimes even less impulse than in the natural condition, notwithstanding the distress complained of by the sufferer. Palpitations of this kind are peculiarly intractable, and are accompanied with great præcordial anxiety, and a sense of vague apprehension. In scurvy, likewise, in which the blood and muscular tissue, and indeed all the solids and fluids, are so remarkably altered, difficulty of breathing and infiltration of the cellular membrane are very frequently associated with palpitations.

Amongst the most frequent *exciting causes* of nervous palpitations are to be reckoned not only the stronger mental emotions, such as joy, fear, or anger, but also those of a more depressing and prolonged character, as sorrow, care, or longing. Protracted mental exertion, late hours, sexual excesses, uterine derangements, large depletions, hæmorrhages, or exhausting discharges; in short, whatever tends to debilitate the system generally and augment the nervous excitability, favour their production. The dyspeptic and hypochondriacal, the gouty and the hysterical conditions are peculiarly prone to them. Irritation of the stomach or intestines, as by the ingestion of food in excessive quantity, or of a flatulent, indigestible, or acrid nature, and the presence of worms, and more especially tænia, are well established causes of such palpitations. In some individuals the presence of an excess of acid in the stomach, or its over-distention from flatulence, is sufficient greatly to derange the heart's action, and render it strikingly irregular or intermittent. Partly through the medium of sympathy, and partly in consequence of pressure, an enlarged liver or spleen or other abdominal tumours, ascitic effusions and the gravid uterus exercise a marked influence in the production of palpitations, as does likewise compression of the abdomen and chest by the absurd practice of tight lacing. Addiction to spirituous potations is a very frequent source, not only of this functional disorder of the heart, but often we believe, also of organic disease. How powerful an agency both tea and coffee exert in deranging the motions of the heart, in particular idiosyncrasies, is not commonly fully appreciated in this country, where their long habitual use as articles of diet has in a great degree blunted our curiosity as to their energetic qualities. Yet it is a well established fact that tea, whether black or green, even of moderate strength, will in some individuals, and especially those who are abstinent in respect to wine and other fomented liquors, and who are of studious and sedentary habits, produce violent disorder of the heart's motions, rendering them at one time vehement and tumultuous, and at another so irregular, intermitting, and feeble as to threaten instant deliquium. The respiration likewise occasionally becomes irregular and oppressed, and there is sometimes acute spasmodic pain in the præcordial region, together

* The musical murmurs, also, are supposed by Dr. Hope, from their sustained character and usual co-existence with the continuous venous hum, to have their origin in the veins.—

with much of the mental anxiety which characterizes an attack of angina pectoris. These effects are, as we have satisfied ourselves, by no means rare; many individuals continuing to suffer from them in various degrees for months and even years without ever suspecting their origin. When once ascertained to be productive of these consequences, this beverage should of course be at once and permanently renounced. The distressing sensations alluded to above may, however, be entirely and almost immediately removed for the time by a glass of brandy or other strong stimulant.

Embarrassment to the pulmonary circulation may likewise give rise to palpitations, whether caused by hepatisation of the lung, or the presence of tubercles in large quantities, or by the encroachment of a tumour or of a fluid within the pleural sac; and an irregular or rachitic conformation of the thorax, likewise favour their occurrence in a remarkable degree, as pointed out by Testa. Spinal irritation, more especially when seated in the cervical or dorsal region, is ordinarily accompanied with a disposition to palpitation; but whether the latter be a direct consequence of the former, or whether it is merely a concomitant result of a more general cause, we shall not here stop to inquire. Palpitation is also a frequent symptom in chorea, and during the debility of convalescence from protracted fevers; and is likewise often a very distressing one in cases of mercurial erithism. We have read of obstinate palpitations being induced, along with severe dyspeptic symptoms, by the irritation of caries of the teeth and alveolar processes, and ceasing on the removal of the diseased teeth; and doubtless many other examples of inordinate or irregular action of the heart brought on from sympathy with painful affections of distant parts might be adduced.

There is still another species of palpitation which has been briefly alluded to by M. Bouillaud, under the title of rheumatic palpitations, often co-existing with wandering pains in the neighbourhood of the præcordial region, and radiating thence towards the left arm. They are occasionally accompanied with intermittence of the pulse, and give rise to considerable alarm on the part of the patient, who may yet be in the enjoyment of good health in all other respects. It can scarcely be necessary to caution the reader against confounding this, which appears to be a rheumatic affection of the cardiac nerves, with the palpitations connected with the rheumatic inflammation of the linings of the heart afterwards to be mentioned.

Diagnosis. How much unwarrantable suffering is inflicted on individuals and families by the deplorable but unfortunately too frequent error of confounding nervous affections of the heart with those of the organic nature, is but too well known to need to be more than simply mentioned here. It is only, however, of late years, or since more accurate grounds for forming a diagnosis of these two very opposite classes of disease have been furnished by the discovery and judicious application of the physical signs distinctive of each, that the better informed portion of the profession has become fully aware of the extent to which such error must have formerly existed. We do not, however, pretend to say that even yet every individual case can be satisfactorily referred to its true head, though certainly a very encouraging advance towards so desirable an object has been, within our own memory, effected. When the supposed nervous palpitations are of very frequent recurrence, or continue for a very considerable period, we may still sometimes find it far from easy to make up our mind decidedly as to their real origin; and where they exist, as is often the case, in complication with structural disease of the heart, to recognise their nature and their precise share in the existing disorder of the functions of the organ is often a matter of extreme difficulty. Bouillaud has given a very striking example of this puzzling complication in the case of a young, nervous, hysterical female, labouring under amenorrhœa, in whom violent palpitations recurred on the slightest causes. Even feeling her pulse at the hospital visit would send the blood at once into her face, and induce vehement action of the heart, with attacks of a spasmodic character, which often passed into an hysterical paroxysm. And yet with all this fallacious nervous susceptibility, by which many a careless observer might have been led to neglect all further exami-

nation of the case, there existed enormous hypertrophy of the heart, with induration of the valves of the left side, during their origin from an attack of articular rheumatism. It appears to us that Dr. Hope goes quite too far in saying "that the diagnosis presents no difficulty to one who to general signs adds a knowledge of those afforded by auscultation and percussion." And even Bouillaud expresses himself somewhat too confidently on this point. Andral, on the contrary, less sanguine, admits that cases will sometimes present themselves when the distinction is almost impossible; both from the circumstance of the symptoms even of a really organic disease of the heart, on the one hand, occasionally almost entirely disappearing for a time; and on the other, from the action of the heart not always completely regaining its normal condition in the intervals of a purely *nervous* palpitation. Thus, for example, a bellows murmur, or some other irregularity of the circulation, may persist for a considerable time in connexion with some slight dyspnœa, indicative of a certain degree of pulmonary congestion; for this latter condition, no less than the palpitation, may, and doubtless does, often originate under the sole influence of a nervous temperament. Besides, as he judiciously remarks, when nervous disorder passes into organic disease, as is sometimes the case, there must be a period in the transition where it will be impossible to ascribe the symptoms positively and exclusively to either.

There is still another class of cases, and of by no means rare occurrence in practice, as to which considerable hesitation is often experienced, namely, when some very slight organic change in an inconsiderable portion of one or other of the lining membranes of the heart still remaining, after an otherwise successfully combated inflammatory attack, gives rise to fugitive palpitations, under the influence of slight exciting causes, though the organ presents no obvious signs of disease in the intervals.

Enough having been said to prove that the recognition of nervous palpitations is not always without its difficulties, it remains for us to enumerate the best means we are as yet in possession of for endeavouring to surmount them.

By percussion, auscultation, and inspection of the præcordial region, we strive to ascertain whether there exists hypertrophy or dilatation of the heart, obstruction of the orifices, or imperfect action of the valves, or any of the results of pericardial inflammation; of the characteristic signs of each of which we shall afterwards speak.

In nervous palpitations, says Laennec, the sounds of the heart, though clear, are not loud over a great extent, and the impulse, though it appear strong at first, does not sensibly throw up the head of the observer. It was on this latter circumstance, taken in conjunction with the increased frequency of pulse, that he chiefly relied for their recognition. The extent of surface over which such palpitations are audible, is, however, sometimes much more considerable than his statement would prepare us to meet with, as they may at times be heard, not only over the whole chest, but even before the head is brought into close connexion with it. The shock of the heart, in cases of nervous excitement, has an "abrupt bounding character," and does not raise the head with the gradual heave of hypertrophy; and the pulse, though it may not be strong, or though it should even be decidedly small and weak, is again, to use the words of Dr. Hope, ordinarily "sharp and jerking." Both this character of pulse and the bellows murmur which often co-exists with it, depend on the spasmodic quickness, and not on the force of the systole.*

In the intervals between the successive attacks of palpitation, when of nervous origin, the action of the heart and arteries is ordinarily natural; and the bellows murmur is of a less permanent character, and often affected by very slight causes,

* Dr. Hope rests his diagnosis on the circumstances of the murmur being always weak, and of the soft or bellows kind, systolic, and confined to the aortic orifice, and, in the anæmic, audible only whilst the pulse continues accelerated, as well as on its being, in such subjects, almost invariably accompanied by venous and arterial murmurs. (Page 386).—AUTHOR.

as by a change of posture, taking of food, a passing emotion, &c. Palpitations of this kind, too, are commonly much more distressing to the patient than is the over-action of the heart connected with organic disease, at least in its earlier stages. Of the latter there is sometimes a complete absence of consciousness; whilst the former, on the contrary, are the source of perpetual complaint. This internal perception is indeed highly characteristic of nervous palpitation. The different effects of motion and rest on the two kinds of disease are also very conspicuous. Insufficient exercise, especially in combination with too high a scale of diet, when the subject is plethoric, is sure to exasperate the nervous variety; and it is in the recumbent posture, and during the attempts to procure repose in the earlier part of the night, that the annoyance from them is most marked; and they are least noticed when the individual is actively employed in the open air. In cases of organic affection, on the contrary, the least over-exertion leads to immediate exasperation of the symptoms, distressing dyspnœa, &c., and the over-action of the heart is commonly more prolonged. The most obstinate palpitations met with in practice are those when dilatation co-exists with thinning of the walls of the heart. Laennec mentions such a case, when the palpitations persisted for a week, the pulsations being all the while of enormous frequency.

By a consideration of co-existing symptoms, as well as of the temperament and time of life, and of the period which has elapsed since the commencement of the disorder, much additional light may be thrown on the nature of the case. When the patient is of a very irritable habit, or subject to other affections of a nervous character; when the attacks are accompanied by an abundant flow of pale urine; or, finally, where dyspepsia, or any of the other exciting causes, above alluded to, have preceded the tendency to palpitation, we shall have reason to hope, at least till fuller investigation has been made, that the disorder of the heart may be only functional. Too much stress is, however, often laid on the presence of dyspeptic symptoms, as if almost diagnostic. It should not be forgotten that derangement of the stomach, and even the temporary distention caused by food or flatulence, may very materially aggravate those palpitations, also, which have their origin in organic disease.

The period of life most subject to nervous palpitation is that of puberty, and for a few years subsequently. It is very common in students, and more especially those of the medical profession, whose attention is so much directed to their organization; in females, likewise, in the flower of youth, and more particularly those in whom the menstrual function has either not been fully established, or become in some respect deranged; in puerperæ, especially after large losses of blood; and in pregnancy, from sympathy with the enlarged uterus, from the pressure it causes, as well as from the accompanying plethoric condition of the system. Organic affections of the heart, as is well known, ordinarily make their appearance at a more advanced period of life, and often in persons of the stoutest make and most active habits.

When palpitations are of the nervous kind, there is occasionally felt a pricking sensation over the præcordial region; and on applying the stethoscope, the increased action, unlike to what takes place usually in organic disease, is equally audible on both sides of the heart. Congestions of the chest and head, moreover, are rare; there may, indeed, be uneasy or painful temporary nervous sensations connected with the brain, the senses of sight or hearing; but no evidence of permanent cerebral determination, such as heavy dull pain of head exasperated by stooping, throbbing of the temporal arteries, prominence and redness of the eyes, excessive sleepiness, stupor, and apoplectic tendency; nor is there in most of its varieties, even after their long continuance, with the exceptions to which we have already alluded when speaking of chlorosis and scurvy, any marked disposition to dropsical effusion. The results of treatment and of attention to diet, air, and exercise, and the careful avoidance of all exciting causes, will tend still farther to clear up the nature of the case.

Treatment. As nervous palpitations vary so much in respect to their causes,

and the states of body in which they make their appearance, very different and even opposite plans of treatment are obviously required by them. There is one rule, however, which is applicable to all, namely, to remove the exaggerated apprehensions of the sufferer by assuring him, where it can be done with truth, of the absence of organic disease; the very dread of which has so powerful an influence in exasperating the symptoms. To modify as far as possible any thing morbid in the general habit of body, and to avoid the exciting causes of the attacks, wherever they can be discovered, are self-evident indications, in the neglect of which, and more particularly of the latter, all other measures will for the most part prove quite unavailing.

A plethoric condition is to be combated by a reduced scale of diet, active exercise, early rising, and aperients, in addition to which the local or general abstraction of blood will sometimes be necessary.

An anæmic or chlorotic state, on the other hand, requires a liberal supply of light nutritious food, a pure dry bracing air, agreeable occupation, easy exercise, frequently repeated in the course of the day, and in conjunction, if possible, with change of scene. In connexion with these, tepid or cold shower-bath or sea-bathing may be had recourse to, along with the exhibition of tonic medicines, more especially artificial preparations of iron or chalybeate mineral waters, bark, quinine, the vegetable bitters, with the alkalies or mineral acids, and occasional warm aperients. Nitrate of silver, in combination with extract of hyoseyamus, is spoken of with commendation by Dr. Copland: it is a medicine, however, not to be lightly had recourse to, nor from the well-known inconveniences connected with its long-continued use, to be too perseveringly exhibited. The same author has seen a strong infusion of green tea, taken three or four times a-day for some days in succession, quiet obstinate nervous palpitations; but from its well-known power of deranging the heart's action in many individuals, and of itself producing violent and irregular action of the organ, of which we have met with numerous instances even in stout and active individuals, we apprehend that the cases in which it will prove useful are but few.

In both varieties of the disease above alluded to all co-existing disorder of other organs, and more especially of the uterine and digestive system, is to be carefully investigated, and, if possible removed. In amenorrhœa, occurring in connexion with the plethoric condition, the application of leeches to the thighs, along with aloëtic purgatives, will often be of service; but when this functional derangement originates, on the contrary, in the chlorotic state, all attempts at removing either it or the associated palpitations, will probably fail, till the morbid state of the system at large, of which it appears commonly to be but one of the manifold effects, has been in some degree counteracted. Griffith's mixture, or pills of the sulphate iron, along with aloes and myrrh, to which in some cases a moderate portion of a narcotic extract, to counteract irritation, may be added, will tend in some degree to fulfil both the local and the general indications; but it is chiefly on the dietetic resources already insisted on that we must place our dependence. As to the palpitations so often occurring in hysteria, they generally fall under one or other of the varieties we have been treating of; and for any farther peculiarity of management required by them, we must refer to the article specially devoted to that protean affection. The appropriate treatment of dyspepsia, likewise, will be found at length in another portion of this work; so that we need here only remind the reader of the importance, in such cases, of avoiding all indigestible ascendent or flatulent kinds of food, and of abstaining from such excess, whether in solids or liquids, as would over-distend and debilitate the stomach. Immediate temporary relief of the palpitation is sometimes consequent upon the exhibition of an antacid, a carminative, or a mild emetic, when there is reason to suspect that the stomach has been overloaded with food, distended with gas, or irritated by acidity. In cases where there exists considerable irritability of stomach, prussic acid has been found by Dr. Elliotson of so much use that he is disposed to consider the marked relief afforded by it as almost diagnostic of functional derangement arising

from this source. The bowels should be regulated, but by no means powerfully acted on. *Many dyspeptic and more especially delicate females, often, we believe, induce or exasperate palpitations of the heart by the injudicious use of drastic purgatives. Where they appear to be connected with congestion of the liver, its secretion should be freely promoted, and a few leeches applied, either over this organ, or, still better, to the hæmorrhoidal vessels. When the suppression of any habitual discharge, or the sudden removal of a cutaneous eruption, has been followed by palpitations, the establishment of some vicarious action is the practice which both reason and experience indicate as best. If the affection is connected with gout, an habitually free state of the bowels is peculiarly important, and should be effected, if possible, through the medium of the diet; otherwise by the use of an appropriate aperient, and more especially by the free use of magnesia. The fluid effervescing preparation of this medicine, invented some years ago by Sir James Murray, is peculiarly suitable in these cases, where its use has to be so long continued, inasmuch as it has neither the disagreeable taste nor liability to concrete within the bowels, of the ordinary form. During the fit of palpitation, which is often very violent and attended with peculiar anxiety and sense of sinking, an opiate or some of the milder narcotic extracts may be given with advantage, in strong camphor mixture or some other cordial medium.

The existence of spinal irritation, where an altered regimen and the enjoyment of a pure country air fail of procuring relief, calls for the application of leeches and counter-irritation to the tender portion of the back. Where the palpitations seem to depend on extreme excitability of the nervous system generally, and of the cardiac nerves in particular, independent of any discoverable disorder in other organs, digitalis or prussic acid may be cautiously had recourse to, along with active and continued counter-irritation over the præcordial or corresponding dorsal region: whilst at the same time every means of favourably modifying the prevalent nervous temperament should studiously be put in practice,—such as living much in the open air; adhering to early hours; using as much exercise as is consistent with the strength; practising temperance without abstemiousness; and, above all, keeping the mind at ease, and not over-working the brain.

As to the palpitations which accompany the different kinds of asthma, we must refer for their treatment to the various diseases of the heart and lungs, of which the asthmatic paroxysm is symptomatic.

SYNCOPE.

Symptoms.—*Causes.*—*Effects of the injection of air into the veins.*—*Diagnosis.*—*Treatment of syncope founded on its various causes.*

SYNCOPE, or that temporary loss of consciousness and motion which ensues when the brain, in consequence of the sudden depression of the heart's action, is no longer adequately supplied with blood, is, as we shall have occasion to notice in a subsequent part of this work, a frequent and very alarming symptom in many organic diseases of the last-named organ; but it is also prone to occur from very slight causes, in the absence of all such structural change, in those of a nervous and debilitated habit, and more especially in delicate females of the upper and more artificial classes of society, who are too often rendered morbidly susceptible by luxury, indolence, and self-indulgence.

The precursory *symptoms*, ordinarily present, consist in a painful sense of faint-

ness,* sinking, or dead sickness; clouded vision, with the perception of various imaginary colours; ringing and rushing sounds in the ears; vertigo and confusion of head; coldness and tingling in the extremities, and cold perspirations, along with extreme paleness and collapse of the features. In some rare instances, as, for example, where the mind receives a sudden shock, syncope has been known to take place immediately, and without the occurrence of any of these warning signs. Where the individual faints outright, the breathing becomes almost imperceptible; consciousness is extinct; the pulse at the wrist can no longer be felt; the contractions of the heart are extremely feeble, its first sound being greatly diminished in intensity, whilst its second sound is commonly inaudible.

This condition continues for various periods, from a few seconds to some minutes; or, in a minor degree, even for hours or days, as in those embarrassing cases of suspended animation which are occasionally, with so much difficulty, distinguishable from death.

As the fainting fit goes off, the respiration becomes stronger; reaction manifests itself in the circulatory system in the increasing energy of the heart's pulsations and in the refilling of the capillaries, as well as in the gradual though often painful return of consciousness and voluntary motion.

Of the *causes* productive of syncope, some act primarily on the brain and nerves; as, for example, peculiar odours and powerful miasmata, disgusting or painful sights, affecting strains of music, mental shocks, destructive bodily injuries, agonizing pain or intense pleasure, concussion or inflammation of the brain or ganglionic centres, fatigue, inanition, &c. Others produce their effect through the medium of the circulation, as excessive losses of blood, as in the case of surgical operations, wounds, or floodings after delivery; or profuse evacuations, as in cholera, violent diarrhœa, prolonged lactation, or the sudden removal of pressure off the abdominal vessels and viscera, as in the case of parturition, or rapidly drawing off the fluid in ascitis, especially when proper bandaging is neglected. Even the premature assumption of the erect or sitting posture by convalescents from fever, or others in an extreme state of debility, is often sufficient to produce a very dangerous or even fatal syncope; these postures, as we have already seen, having a very considerable power of weakening the force of the heart's pulsations, and apparently exhausting the irritability by the enormous augmentation of its speed: nor can we believe that the gravitation of the blood, is, in such instances, without its influence.

In the very opposite condition, or that of plethora, syncope is likewise not an infrequent occurrence, appearing to originate in a temporary oppression of the heart and great vessels. Instances from this source is not rare in pregnancy and certain forms of hysteria; though, in regard to both, the co-operation of sympathy or co-existing nervous disturbance is not to be overlooked. It will indeed be found impossible in many other instances as well as these to refer the exciting agency to a simple source: thus, in respect to many of the various poisons, mineral and vegetable, by which syncope may be induced, part of the influence is ascribable to the direct action on the nervous system, part to the extreme exhaustion consequent on the incessant discharges, and part to sympathy of the heart with the suffering organs. Some, however, manifest their influence over the heart with peculiar rapidity: the fatal syncope induced by prussic acid is almost instantaneous; that from tobacco very rapid; whilst the tendency to the same result when induced by digitalis is, on the contrary, of a peculiarly insidious and accumulating character, being brought on by even small doses of this substance when long-continued, and persisting for a considerable time after they have been renounced.

* This is not universally true; in some individuals the sensation is decidedly pleasurable: such was the case with Montaigne.—AUTHOR.

The tendency which exposure of the surface of the body to a high temperature has to produce fainting is familiarly known in the instances of hot bath, overheated apartments, standing long with the back to a powerful fire, &c.; the effects being ascribable to the influences of these causes as well on the nervous system as on the distribution of the blood.

Amongst the most rapid and fatal instances of syncope is to be placed that induced by the forcible and sudden *injection of air into the veins*, which, after it has reached the heart, seems immediately to arrest the circulation. As to the primary cause of death under such circumstances, there has been much difference of opinion amongst physiologists. By Nysten and Bichât it was ascribed to the effect of the air on the brain (compression of the organ, according to the former, being produced;) by Boerhâave to the clogging of the pulmonary capillaries, and consequent interruption of the circulation; by Leroy to emphysema of the lungs; and by Magendie to loss of power in the right ventricle from over-distention. A much more satisfactory explanation than any of these was proposed a few years ago by Dr. John Macdonnell.*—"What will usually be found to occur," he observes, "is this: the injected air is quickly conveyed to the right auricle, the contraction of which drives it partly back in the veins, partly into the ventricle. The auriculo-ventricular valve is incapable of completely confining the air; and, instantly that the auricle relaxes, it is again filled with air, partly from the ventricle, partly from the veins. In this way the auricle will be observed, at the instant of each relaxation, to become distended with air, which thus stops the circulation, and, of course, causes death." As to the causes to which Nysten and Boerhâave attribute it, he does not deny the possibility of their being occasionally concerned, but successfully impugns the hypothesis of Magendie as being quite incompatible with the observed facts; for blood and air mixed continue to be forcibly ejected from the wounded vessel even after the animal has become insensible, which indicates sufficiently that the right side of the heart continues capable of powerful action.†

* Dublin Medical Journal, July, 1835.—AUTHOR.

† The occasional spontaneous introduction of air into the larger veins in the neighbourhood of the heart, during surgical operations, has excited much interest of late years since attention was first called to it, by Beauchêne, and more particularly since the occurrence of Dupuytren's celebrated case. The experiments made before the recent Commission of the Royal Academy of Medicine, by M. Amussat, have thrown some new light on this obscure subject. From these it appears that it takes place only in that portion of the great veins which are situated near enough to the chest to be the seat of the venous pulse, or that flux and reflux of the blood taking place under the influences of the respiratory movements,—as the lower third of the external jugular, for instance, and the sub-clavian vein; or if such introduction of air occasionally occurs in somewhat more remote parts, it is only when the orifice in the vessel is held open, and not even then in veins which are considerably more distant, as the brachial, for example.

Where air is artificially injected into the veins of the lower animals, the effect varies with the quantity introduced, and the force and rapidity with which it is thrown in. Thus, in some instances, death ensued within two or three minutes; in others, though there was an appearance of extreme anxiety, with great embarrassment of the respiration and circulation, extreme debility, convulsions, and tetanic spasm, death did not take place for near half an hour; whilst in others again, when the quantity was very inconsiderable, little uneasiness was manifested, and the animal speedily recovered. The physical signs of air in the veins were a lapping or gurgling noise within these vessels, synchronous with the inspirations, and occasionally also with the diastole of the heart, in which organ, likewise, a bellows-murmur was heard, with or without a gurgling sound. On dissection, if immediately performed, the right side of the heart and the pulmonary artery were found distended with frothy blood; the left side at this period being entirely free from it, unless in such large animals as the horse, where the greater size of the capillaries of the lungs was supposed to have admitted more readily of

A large draught of cold water, taken whilst the body is overheated and debilitated by violent exercise, has been known almost immediately and entirely to arrest the heart's action. But, of all agents, electricity in an accumulated form is that which most instantaneously and irrecoverably puts a stop to the heart's motions, seeming to act simultaneously on the nervous and muscular systems and on the blood, destroying at once the sensibility of the first, the irritability and contractility of the second, and the power of coagulation in the last.

The cases in which fatal syncope more usually presents itself in practice are either those in which, there having been extreme previous debility, some unsuitable posture has been assumed, or some exhausting muscular effort attempted, some intensely painful operation performed, or injudicious evacuation practised; or those in which sudden and irreparable exhaustion has been induced by an inordinate loss of blood; or, finally, those in which the heart has long been suffering from a state of organic disease, as softening or atrophy of its tissue, or passive dilatation of its cavities. In the last-mentioned order of cases, so great is occasionally the weakness of the circulation, that a portion of the blood seem sometimes to coagulate within the heart before life is yet extinct; the polypous concretion so formed becoming the immediate cause of the fatal syncope. A few instances are on record of individuals who have died quite suddenly without any sufficient apparent cause, and in whom dissection having discovered nothing besides an empty and flaccid state of both sides of the heart and of the venæ cavae, we are obliged to refer the fatal termination either to deficient energy of the cardiac nerves, or to weakness of the muscular parietes of the organ, or in short, to a species of paralysis.

Diagnosis. Syncope may readily be distinguished from the partial loss of consciousness occurring so frequently in hysteria, and depending generally on tempo-

its passage. In some instances, the veins of the brain and other parts of the body already contained air; and it existed in them universally, as well as in the arteries, where the animal had survived the experiment, and not being put to death till some days afterwards.

The proximate cause of death is supposed by the Commission to be three-fold. 1st. Enormous distention of the heart, and consequent impediment to its contraction. 2d. Embarrassment of the pulmonary circulation by the spumous blood in the branches of the pulmonary artery. 3d. Compression of the brain by the air in its veins, in some instances.

As to remedial measures, those which appear to promise most benefit are,—frequent compression of the chest, the vein being kept closed in the intervals; the abstraction of air or froth with the syringe; and, lastly, free blood-letting, the efficacy of which was accidentally discovered by Nysten.

There are on record nearly forty supposed cases of the accidental introduction of air into the veins in the vicinity of the chest, in operations on the human subject; yet in very few of these is the actual occurrence of such an event satisfactorily established. Dupuytren's, and perhaps half a dozen others, may be admitted as genuine. In these there was heard either a gurgling noise, or a sound of air rushing through a narrow aperture; and this was, for the most part, almost immediately followed by fatal syncope. In one instance, death ensued almost instantly after opening the jugular vein for the abstraction of blood in a case of apoplexy. In all the indubitable examples of the accident in question, air was found in the vessels, both arteries and veins, of the brain and rest of the body, and in some of them also in the right ventricle of the heart. Still it is far from certain that the air so introduced was always the sole or even principal cause of death; for, in the first place, there were numerous other influential causes in operation, as loss of blood in some instances, exhaustion from pain or fear in others, oppressive determination to the head in others: and, in the second place, the symptoms and effects differ considerably from those induced by the direct injection of air in the lower animals; convulsions were not commonly present,—death was much more sudden. Distention of the right side of the heart with frothy blood was not so constantly observed, and the quantity of air introduced was apparently much less. (See a very able analysis of the evidence on this subject, in *British and Foreign Medical Review*, No. XII.)—AUTHOR.

rary congestion of the brain rather than on deficient circulation within it, by the colour of the cheeks and lips in the latter affection, by the continuance of the arterial pulse, and finally by the accompaniment of other hysterical symptoms, as globus pained in the left side, alternate fits of laughing and crying, &c.

The *Leipothymy* of Sauvages, or that condition which is characterized by the fixed eye and appearance of abstraction, or rather of impaired consciousness, by the momentary cessation of voluntary motion and by the restrained respiration, a condition which so often ushers in the epileptic paroxysm, and which seems to consist in a passing congestion of the cerebral vessels, may be discriminated at once by the pulse remaining firm throughout the seizure, as may likewise the epileptic attack itself by the same circumstance taken in connexion with the violent agitations of the body, the foaming at the mouth, &c. Apoplexy, or pressure on the brain by effused blood or serum, or extreme congestion of its vessels, is sufficiently characterized by the heavy stertorous breathing, and commonly by the full strong pulse and congestion of the vessels of the face; as is asphyxia by the swollen livid features, and the distention of the capillaries with unarterialized blood, indicative of the function of the lungs having ceased prior to that of the heart. And, finally, real death may be distinguished from syncope by the total and prolonged absence of both sounds of the heart, and of every trace of respiratory movement or pulmonary vapour; by the cadaveric stiffness of the limbs; the sinking of the temperature in the interior of the body, as judged of by the introduction of a thermometer into either end of the alimentary tract, or under the axilla; the complete absence of all evidence of sensation, even on the application of the strongest stimuli to the nerves of the skin and to the other organs of sense; by the blackish hue of the sclerotica when it has been exposed for some time to the air; by the filmy sunken appearance of the cornea; and by the bluish or reddish streaks throughout the skin, but especially on the most dependent parts; or, if these signs fail to force conviction, by awaiting the occurrence of the odour and discolourations of incipient putrefaction.

Treatment. The objects of treatment consists in abbreviating or anticipating the attack, and, in the intervals, gradually counteracting the local and constitutional causes of its occurrence. During the period of the premonitory sensations, the obvious means of preventing the occurrence of complete syncope consists in placing the patient in the horizontal posture: the removal of all pressure of clothes, &c. on the throat, chest, and abdomen; the free admission of fresh air, to stimulate the lungs and surface of the body; cold aspersion, to excite the cutaneous nerves and call the associated respiratory muscles into full action; together with sharp volatile errhines, a drink of cold water, or, if within reach, a stimulant aromatic draught, containing either ammonia or camphor, or a glass of wine, or other easily obtained stimulant, if there be no suspicions of inflammatory disease; in short, all such means as are known temporarily to stimulate the nervous system, and augment the action of the heart and lungs. Tight ligature on the limbs, so as to impede the flow of blood to the extremities,—once a popular remedy,—have been recently alluded to by Mr. Wardrop, who countenances their employment, and endeavours to account for their influence on physiological principles. When fainting has taken place outright, most of the above measures, with the exception of the introduction of fluids into the stomach, will still be practicable and proper, and will ordinarily suffice to shorten the attack. The common people, in such cases, often cry shrilly in the ears, slap the palms of the hands, or use other familiar methods of awakening the dormant sensibility. In instances of obstinate and prolonged suspension of animation, it may be proper to employ, moreover, stimulant injections of camphor, turpentine, &c. together with frictions of the limbs and trunk; to apply warm embrocations to the pit of the stomach and præcordial region; and avail ourselves of the agency of heat in a still more energetic form, as by means of the bowl of a spoon or head of a hammer, plunged for a few seconds into boiling water, and then brought into momentary contact with the cutaneous nerves, more especially in the situations just mentioned, or to the corresponding

portion of the spine: and in extreme cases, which, from the prolonged silence of the heart, or unnatural and increasing interval between its sounds, seem to verge upon dissolution, the introduction of warm and exciting fluids into the stomach by means of an elastic tube, the assiduous employment of artificial respiration, and, perhaps, also of electricity, should be resorted to. From analogy we should anticipate benefit, in some of these cases, from the momentary dashing of cold water, from a height, on the upper portion of the spine; care being taken not to produce any permanent or general reduction of the temperature of the body, inasmuch as to support the animal heat is an indication of primary importance.

It can scarcely be necessary to recall to the reader's mind, that the prevention of syncope is not always desirable; that in inflammatory affections, for instance, when blood-letting has been practised, the good effects of the operation are probably sometimes much augmented by its occurrence; whilst any attempts at preventing it, by the exhibition of stimulants, could not fail to counteract its beneficial results, and ought, therefore, for the most part to be scrupulously avoided. There are, however, on the other hand, many cases in which, though blood-letting in moderate quantity may promise great relief, as, for instance, in certain stages of organic affection of the heart, the supervention of syncope would be attended with extreme risk; and there are very few cases, indeed, of any kind, in which we should venture to bleed to this extent in the horizontal posture. The ready occurrence of fainting on the loss of a very small quantity of blood may generally be considered as a proof of blood-letting being inappropriate, either to the disease in which it has been employed, or at least in respect to the period of its performance; and has been referred to, by Dr. Alison, as one of the means of distinguishing incipient idiopathic fever from the constitutional effects of a local inflammation. Dr. M. Hall thinks we have a criterion of the quantity of blood proper to be drawn in any disease, in the facility with which syncope is induced,—the patient being in the erect or sitting posture: and accordingly its supervention, from the loss of very moderate quantities of this fluid, is thought to indicate certainly the absence of formidable inflammation; whilst, on the contrary, the tolerance of very copious evacuations of this kind is looked upon as sufficient evidence of their appropriateness. Thus, for example, whilst in a state of health, incipient syncope is induced commonly by the loss, on an average, of about 15 ounces of blood; in congestion of the brain, from 40 to 50 ounces may be often taken before the same effect ensues; in inflammation of serous membranes, from 30 to 40; of parenchymatous parts, about 30; of the skin and mucous membrane, about 16; in fever and the exanthemata, from 12 to 14; whilst in delirium tremens, puerperal delirium, concussion of the brain, intestinal irritation, dyspepsia, or chlorosis, and, above all, in cholera, the abstraction of a much smaller quantity will commonly have the same result. These views, however, have not been universally adopted; and Dr. Clutterbuck, in particular, whose experience in regard to blood-letting has been peculiarly extensive, has very recently raised his voice against them. Whilst he does not altogether deny that the approach to syncope in the erect posture may be a test of the quantity of blood which can be lost with safety, he asserts that it is, alone, no true measure of the quantity proper to be taken; for the period at which syncope occurs will vary with the size of the aperture, and the rapidity with which the blood escapes, no less than with the quantity drawn; and hence, if it flow very quickly, fainting may set in before enough has been obtained to make any permanent impression on the disease; and if on the contrary, very slowly, an unnecessary and injurious diminution of the circulating fluid may be undergone before the same state is induced. And again, the observance of the rule in question would lead very commonly, it is asserted, to a wasteful expenditure of the vital fluid, as inflammations can very often be controlled without pushing depletion to the length of syncope.

In hæmorrhage from wounds, &c., fainting seems to be one of nature's remedies for promoting the contraction of the bleeding vessels, and the formation of a

coagulum. When, however, mechanical means of commanding the hæmorrhage are at hand, and especially when the loss in this way has already taken place to a formidable extent, the judicious practitioner will not, of course, for a moment, hesitate to interfere and arrest the farther flow of blood, and anticipate the occurrence of such a state; unless under the existence of some very peculiar counter-indicating circumstances. In syncope connected with diseased heart, or with uterine hæmorrhage, such interposition, the peril being imminent, is loudly called for from the very first. In the former, our resources are unfortunately very limited, scarcely extending beyond the exhibition of diffusible stimuli, and the application of warmth and friction to the surface, and other excitants of the cutaneous nerves and capillaries, in the manner previously alluded to. In the latter, the invaluable aid we possess in the tampon or plug, in the form of a sponge, or a common silk pocket handkerchief oiled, and gradually introduced into the upper part of the vagina, should never be forgotten, as by means of it, together with the judicious employment of opium and other stimulants, many a valuable life may be saved.

In cases of syncope originating in plethora, exciting medicines should, as a general rule, be religiously abstained from, abstraction of blood being the obvious remedy. On the contrary, in the very formidable cases of fainting connected with passive dilatation of the heart, and with lesion of its valves and orifices, blood-letting is a very doubtful resource, its use requiring the greatest caution; and being suitable, when at all, rather in the intervals than during or impending the attacks: whilst in softening and atrophy of the heart it is in the strongest degree counter-indicated, the proper remedies for a sudden sense of sinking and fainting connected with these conditions being the instant exhibition of powerful cordials, hot drinks, sinapisms to the præcordial region, active friction along the spine and on the extremities, and rigid restriction to the horizontal posture. In the syncope dependent on inflammation of the heart and its membranes, stimulants would be no less misplaced than depletions under the circumstances just mentioned. In this, as well as in the other cases above enumerated, the necessity for abstaining from all strong mental emotions, and all needless muscular exertions, is self-evident.

Where a tendency to sickishness and fainting is the immediate result of a surfeit, or of something having disagreed with the stomach, the propriety of an emetic, at least where there is no counter-indication from disease of the heart or great vessels, &c., is obvious; as likewise in the case of poisoning by acrid and narcotic substances.

The syncope which is caused by a large draught of a cold fluid taken when over-heated and in a state of extreme exhaustion, demands the most prompt and energetic measures. It is sometimes preceded by spasms of the stomach; and here the application of heat to the epigastrium, as by means of a bladder filled with warm water, the introduction of laudanum in a large dose into the stomach, along with hot brandy and water and other stimulants, should be had recourse to without the loss of a moment of time. If the power of swallowing is already lost, by the intervention of the stomach-pump and stimulant injections we may still make an effort to save the sufferer's life.

We have known a person to drop down insensible in the street, immediately after drinking a bottle of soda water; the seizure, however, being momentary, and not giving rise to any subsequent ill effects. In such a case we must suppose, either that the sudden distention of the stomach by the liberated gas arrests the heart's action through the medium of sympathy or pressure, or else that the obstruction of the great vessels produces a state of extreme but temporary congestion of the brain.

The rapid secretion of gas in enormous quantity into the stomach and intestines, and the consequent impediment to the motion of the diaphragm, the compression of the heart, and impairment of pulmonary dilatation, have recently been adduced to explain a case of sudden death when no other morbid appearance suf-

ficient to account for the fatal event was discoverable on dissection; and the well-known effects of speedy gaseous distention of the abdomen, on cattle which have gorged themselves with certain green foods, countenance the explanation.

Instant death has been supposed, in cases of a different kind, to have been induced by the sudden over-distention of the cavities of the heart with blood;* and a palsied state of the organ certainly appears very rapidly to be induced in persons asphyxiated, in part by the quantity as well as by the quality of the blood with which, in consequence of the stasis in the pulmonary vessels, it soon becomes inordinately dilated.

In addition to the sources of syncope already enumerated, the spontaneous development of a gaseous fluid in the blood has been recently suggested by M. Ollivier as a possible cause of the total cessation of the heart's action; acting either mechanically by inordinate over-distention of the right side of the heart, or as a poison if it consist mostly of carbonic acid or any equally deleterious agent (*Révue Médicale*, Feb. 1838:) and he adduces a case of sudden death taking place in a debilitated patient in the effort of rising, where dissection detected nothing but the gaseous dilatation here spoken of.

As for the means to be put in practice, in the intervals of attacks of syncope, for the removal of the local and general conditions on which, when habitual, they depend, we must refer the reader to what has been said in the preceding sections on the modes of strengthening and regulating the nervous, muscular, and other systems.

In connexion with syncope, we may allude to cases in which the action of the heart may be enfeebled.

The action of the heart may be enfeebled in various degrees, from a momentary flutter up to actual syncope, either from want of energy in the organ or from deficient excitement, or, finally, from the embarrassment of the circulation connected with organic disease. The derangement originating in the last-named cause does not fall within the scope of the present section. That such weakness may manifest itself in a very alarming form, altogether independently of any structural lesion of the heart, is matter of every day observation: and its source may then commonly be traced up, either to the participation of the nerves of the heart in a general depression of the nervous system; or to a deficiency, sudden diminution, or impoverishment of the blood; or to sympathy of the heart with disorder in some other organ. In susceptible individuals an apparently slight cause will often suffice to induce formidable derangement of the heart's action. Thus the pulse may become not only feeble and fluttering, but of varying strength and frequency, irregular and intermitting, from a passing disorder of the stomach, or a mere flatulent distention; from the temporary oppression of the heart by too rapid an afflux of blood; or from a momentary emotion of mind, or a disagreeable impression made on the senses. Where these attacks are preceded or accompanied by a prolonged sense of faintness and anxiety, an antispasmodic or stimulant draught should be given to procure present relief, and prevent them passing into syncope; or where there is reason to suspect the presence of offending ingesta in the stomach, a mustard emetic, as best suited to clear out this organ without augmenting the debility, should be had recourse to. In their intervals the tendency to recurrence must be combated by attention to the digestive organs, by the correction of plethora or anæmia when either of these states exists, and by strictly following out the hygienic principles set forth in the last section.

* Leuwenhoek, quoted by Elliotson in his *Physiology*, p. 483.—AUTHOR.

ANGINA PECTORIS.

Symptoms.—Seat and Nature.—Complications.—Diagnosis.—Treatment.

THIS severe spasmodic affection, termed also *Syncope Anginosa*, *Sternalgia*, *Asthma Arthriticum vel Diaphragmaticum*, *Suffocative Breast-pang*, &c., for the first clear account of which we are indebted to Heberden, consists in a sense of constriction in the præcordial region, and more especially under the inferior portion of the sternum, with a feeling of numbness and pain extending thence to the left arm, and is attended by apparent difficulty of breathing, intense anxiety, and apprehension of impending death.

Symptoms. It makes its appearance ordinarily, for the first time, suddenly as the person is ascending a hill, especially if the wind is in his face; or undergoing some unusual exertion soon after eating. The excessive pain and sense of suffocation and fainting, oblige him, if walking, instantly to stop, and he commonly feels as if he should die were he to persevere. By a momentary repose, his sufferings, at least towards the commencement of the disease, ordinarily vanish for the time, leaving behind only a dull aching or uneasiness within the chest. The attacks recur at uncertain intervals, at first, of weeks or months, or even still more protracted periods; but become subsequently gradually more frequent, of longer duration, and sometimes, though perhaps not generally, of greater intensity. The paroxysm is, at a more advanced period of the affection, much more easily excited; emotions of mind, intense thought, the actions of eating, coughing, or relieving the bowels, being now sufficient to bring it on. It will at this stage even occur as the individual lies at rest in his bed, and especially immediately on awakening from the first sleep; in which respect it coincides, as Heberden remarks, with many other spasmodic nervous affections.

The pain, which at first was confined to the chest and upper part of the left arm, reaching commonly only as far as the insertion of the deltoid and pectoral muscles, afterwards often extends along the ulnar nerve down the inside of the arm to the elbow, wrist, or even to the fingers. It occasionally, though rarely, affects the right arm also, the neck, and lower jaw towards the ear, causing a feeling of choking and difficulty of articulation; and may even reach, though this is much more uncommon, to the lower extremities. The pain often follows the course of the anterior thoracic nerves, more especially of the left side; and in females there is at times, from this cause, extreme tenderness of the breasts. In some anomalous cases the painful sensation has been known to originate in the arm, not being at all felt in the chest till a more advanced period of the disease.

The duration of the seizure at the commencement rarely exceeds a few minutes, though it may last for half an hour or an hour, and in the more confirmed stage of the affection the paroxysm may be still farther prolonged.

The pulse is subject to great varieties, being in the slighter forms often but little affected; whilst in the protracted and more aggravated cases it is feeble, irregular, or intermittent in some, quick and strong in others; its derangements, which often continue to a certain degree in the intervals, being frequently accompanied by a marked tendency to syncope. The respiration is sometimes affected to such a degree, that the patient cannot continue in the recumbent posture: yet the difficulty of breathing, in the earlier stages more especially, is very unlike spasmodic asthma; for the patient, by an effort of the will, is still able to take a full inspiration, and sometimes finds a momentary relief from the effort. A pa-

tient of great strength of mind has been known to persist in walking, in spite of the vehemence of his sufferings; and his resolution has been rewarded by their speedy cessation. Others, again, have made a similar attempt without the like result; and we apprehend that where the attacks, as is so often the case, are connected with that excited and over-loaded state of the heart induced by muscular exertion, the experiment cannot be exempt from hazard, and especially so if any organic disease exist.

The urine during the paroxysm is commonly clear and pale, as in other affections of a nervous kind, and in some rare cases it has flowed off involuntarily. Flatulence and irritability of stomach are very frequent accompaniments of the attack, the fulness of this organ adding materially to the sense of tension in the neighbourhood of the diaphragm. In the advanced stage of the disorder, the derangement of the digestive organs is a very prominent and distressing symptom at all times.

The face during the paroxysm is in general pale; and the cerebral functions are unimpaired, save in so far as the intense suffering may interfere with their exercise, or the occurrence of syncope for a time cut off the necessary supply of blood from the brain. Yet cases have been met with when, on the contrary, the action of the heart being violent, congestion of the head and convulsions took place.

Where the patient is not previously carried off suddenly by syncope in one of the more violent seizures, as is often the case, well-marked symptoms of structural disease of the heart often eventually manifest themselves; and the scene closes amidst permanent derangement of the circulation and respiration, serous effusions, hæmorrhages, &c.

Seat and Nature. Great difference of opinion has long existed as to the true nature of this affection, some authors looking upon it as invariably connected with organic disease, whilst others view it as merely spasmodic or neuralgic, and consider any co-existent structural changes, (which, they assert, are quite indeterminate in their nature) as mere coincidences, or, if connected at all, rather related as consequents than causes. Reference to the results of the numerous post-mortem examinations recorded by various writers, shows that though organic disease of some kind or other has been found in a large proportion of cases, yet in many nothing of the kind has been detected. We are accordingly disposed to side with those who believe that angina pectoris, at least in its less inveterate modifications, may exist altogether independent of structural changes. It is only in the more aggravated and prolonged cases that such alterations have been very conspicuous. When they occur, their most frequent seat is undoubtedly in the heart, pericardium, or great vessels. Amongst the lesions which have most frequently been met with, are ossification of the valves or orifices of the heart, of the coronaries, or of the arch of the aorta; hypertrophy, dilatation or softening of the heart: excessive fatty deposition, either on this organ or in the anterior mediastinum; effusion into the pericardium or pleura; and disease and enlargement of the liver.

Being comparatively a rare disease, and consequently but few cases falling under the care of any one individual practitioner, of the numerous theories, formed as to its nature and seat upon its first beginning to attract attention, most were deduced from very inadequate premises, each observer ascribing it to that particular form of organic disease in connexion with which chance had most frequently presented it to him. Thus Parry, and several others in imitation of him, referred it to ossification of the coronary arteries; Fothergill to deposition of fat on the heart, and in its neighbourhood; Latham, Brera, and Zechinelli, to enlarged liver, and consequent pressure on the heart, or sympathetic derangement of its function. More enlarged observation has, however shown, that none of these appearances are essential to its production; or, in other words, that it may exist without any of these lesions; whilst they, on the other hand, may be detected on dissection, though none of the characteristic symptoms of angina had been present during life.

Heberden, though, as we have stated, the first express writer on the subject (with the exception perhaps of Sauvages), seems to have entertained more comprehensive and just notions of its true character than the majority of those who have succeeded him. Guided rather by the well-marked morbid phenomena which characterize it during life, than by the variable and uncertain structural changes sometimes found after its fatal termination, he came to the conclusion that it was truly of a spasmodic nature. Thus the attack is ordinarily sudden in its commencement and cessation, the intervals of health being, at least at the first, perfect: mental distress often induces the paroxysm, and opiates and stimulants occasionally procure relief; there is no inflammatory quickness of pulse, and the seizures in the more advanced stage of the disease often comes on, as already mentioned, after the first sleep, as is the case with many other spasmodic affections. Our best recent authorities take very similar views of its nature; thus Laennec thinks that though it often complicates organic disease, and more especially that of the heart, it is in its nature independent of it, being essentially a nervous disorder affecting primarily either the cardiac or the pneumogastric nerves, or both, according as the heart or the lungs and stomach are affected, or all three simultaneously: that the nerves of the brachial plexus become secondarily affected, as likewise the superficial cervical plexus supplying the front of the thorax; and sometimes, but much more rarely, those of the lumbar and sacral plexus, giving rise to pain in the lower extremities, and occasionally to pain and swelling of the testicles. The analogy of its phenomena in diseases of acknowledged nervous origin, as sciatica and tic douloureux, is, he thinks, complete; the prominent features of each consisting in numbness and pain in the course of the nervous ramifications, with which, occasionally, slight tumefaction is associated. M. Desportes had frequently advocated very similar views, save that he limited the source of the disease to the pneumogastric nerve. By M. Andral likewise it is conceived to be a mere "modification of the innervation;" occasionally indeed accompanying organic disease, but then commonly only as a subsequent complication, or, as he states it, an epiphænomenon; or else, on the other hand, obviously preceding the existence of the structural lesion, for many cases terminate fatally before any such permanent alteration has come into being. As a farther evidence as to its true nature, we sometimes find it alternate with nervous affections in other parts, as with gastralgia, sciatica, tic or headach, loss of sensibility in different regions of the body, spasms of the muscles, &c. Dr. Chapman, like Desportes, conceives it to be neuralgia of the pneumogastric nerve originally, spreading subsequently to other nerves, and to those of the heart amongst the number; and supposes that the immediate cause of the irritation consists in irregular or misplaced gout, inasmuch as recovery has been frequently known to ensue on the gouty action being excited in the extremities. Dr. Butter, who with Darwin fancied the affection to be placed in the diaphragm, has likewise ascribed it, as have many other writers of repute, to a gouty source. Dr. Hosack believes it to consist in a plethoric condition, more especially of the heart and great vessels; and similar views are advanced by Dr. Forbes, in his able treatise on this affection in the *Cyclopædia of Practical Medicine*. Dr. Forbes argues that its seat must be in the heart, as well from the frequency of sudden death in the paroxysm, for which derangement of no other thoracic or abdominal organ would adequately account, as from the unquestionable frequency with which cardiac lesions are found in those who have perished by it. These lesions, it is true, are not its immediate or essential cause, which is more probably some unusual irritability of the nerves of the organ; but it is a well established general fact that diseased organs are thereby more disposed to neuralgic pains. He divides the disease into organic and functional, each of these being again sub-divided into the idiopathic and sympathetic varieties. The simple functional angina he conceives to be very rare; many cases set down as such being really examples of a degree of disproportion between the cavities of the heart, which from its slowness has been overlooked. The sympathetic variety,

on the contrary, or that which is called into being by the reaction of disorder in other organs, is comparatively common.

Dr. Hope thinks that any thing capable of irritating the heart, or rendering it morbid and susceptible, may suffice to produce the regular symptoms of angina pectoris; and hence concludes that organic disease of the heart must needs be a most influential cause. He even asserts that he never saw a very aggravated case without such organic disease. The worst cases which have fallen under his observation have been instances of osseous and cartilaginous degeneration of the heart or great vessels, and more particularly of the coronary arteries, the valves or orifices. He believes, that where the elasticity is thus impaired, any exertion which is calculated to over-distend them cannot fail to be productive of uneasy sensations, the amount of which will vary with the nervous susceptibility of the part and of the individual. In the less severe examples of the disorder he has often met with hypertrophy and dilatation, with or without softening of the heart; whereas in the mildest degree of all, which is very common in hysterical and hypochondriacal or dyspeptic patients, occurring in the form of spasmodic aching pain in the anterior part of the chest, extending sometimes to the neck and stomach, with or without pain in the arms, there has been no organic disease at all.

It has been made probable by Dr. Corrigan that several symptoms of the group which generally go under the name of angina pectoris,—paroxysms of dyspnœa induced by exercise, a sense of tearing asunder within the chest, together with anxiety and mental distress,—may originate in aortitis, or inflammation of the mouth of the aorta; which will occasionally yield, even when of rather long standing, to leeching, counter-irritation, and a mild mercurial course. M. Sormani, the editor of Testa's work, likewise seems to incline to the opinion of its being occasionally of an inflammatory, though much more frequently of an organic nature.

No age except that of early childhood seems absolutely exempt from this disorder; in the great majority of instances, however, it does not make its incursions before the fiftieth year. Females are very much less liable to it than males in its severer form, or that accompanied with organic disease of the heart or great vessels; though in its milder grades they often suffer from it. In estimating its comparative frequency in the male and female sex we must not be guided altogether by the printed relations of cases, as it is generally only those of a more formidable character, with organic complications, which have been selected for this purpose. It is more a disease of the higher orders, who live full and take insufficient exercise, and hence have the nervous as well as the vascular system in an unhealthy state, than of the lower or labouring classes.

Complications. We have already called attention to the frequent co-existence of diseases of the heart and great vessels with this affection, and to the powerful predisposing influence they exert in regard to it. Thinness and weakness of the parietes of the heart, and disproportion in various degrees between its several cavities, are, as Dr. Forbes has very justly remarked, amongst the morbid conditions of this organ which may most readily escape observation, and which require therefore to be very carefully sought after.

Dyspepsia, in some of its varied forms, is a very common precursor and concomitant of angina pectoris, inasmuch as it reduces the tone of the nervous system and so renders the heart as well as other parts prone to nervous disorder; and a temporary increase of the derangement of the stomach is, at the same time, no infrequent exciting cause, also, of the attacks of the disorder. Diseased enlargement of the liver, commonly a secondary affection ensuing upon long continued disorder of the stomach and bowels, may, no doubt, in its turn, both by pressure and sympathy, add still farther to the existing morbid tendencies within the chest, though its importance has been greatly exaggerated by Portal, the elder Latham, and Brera.

In females, uterine and hysterical complications are not infrequent. Both ex-

cessive and deficient menstruation exert a very powerful influence in deranging sympathetically the action and nervous sensibility of the heart. But of all the complications, one of the most frequent and important is a plethoric condition of the vascular system—a state which accounts, as Dr. Forbes has remarked, for the frequent co-existence of angina with gout; its ordinary occurrence in persons at an advanced period of life, and more especially in men who indulge in luxurious living, and who, being exempt from the necessity of regular bodily labour, are prone to obesity; as well as for the striking benefit of depletion and a reduced diet in a great proportion of cases.

Diagnosis. The only disease with which angina pectoris is likely by the inexperienced to be confounded is asthma. To the mode of distinguishing them we have already alluded. It is only necessary to add here, that asthmatic attacks, from the first, manifest a preference for the evening or night; that dyspnoea accompanied by wheezing and cough, is their prominent symptom; that there is a craving for fresh air which is quite peculiar; and, finally, a speedy remission of the symptoms on the occurrence of free expectoration,—none of which things are commonly observed in the affection we have been considering. The *prognosis* in angina pectoris depends partly on the vehemence of the symptoms, but still more on the character of the complications. In the mere functional or sympathetic cases of hysterical or dyspeptic origin, especially where the paroxysms are not of a very aggravated nature, it is comparatively favourable, as these conditions are often within the influence of regimen and medicine, and the neuralgic pain is generally of a less obstinate character. It was probably from particular reference to such cases that Laennec spoke of the disorder as one ordinarily of little danger. Where complicated with obvious organic disease of the heart or great vessels, and even in cases where there remains a doubt on this point, and especially if dropsical symptoms have manifested themselves, the prognosis should be a very cautious one. The known frequency of the occurrence of structural change at some period of the disease, as well as its liability to terminate in all its stages in fatal syncope, must ever cause it to be regarded as a very formidable affection.

Treatment. This is obviously divisible into two parts,—the object of the one being to give immediate relief in the paroxysm; that of the other, applicable to the intervals, to reduce the nervous irritability of the heart and of the system generally, and where possible, to get rid of the exciting causes, and more especially of such functional derangement in other organs as is known to exercise a disturbing influence over the heart. The treatment proper, both during the seizure and subsequently, will in a considerable degree depend on the state of system in which the disorder makes its appearance. Where the patient is of a debilitated nervous habit, the use of carminatives, stimulants, antispasmodics, and anodynes are our chief resources, though unfortunately often very inadequate ones, during the paroxysm. The relief ordinarily ensuing on the expulsion of flatulence justifies the use of the first named class of remedies. The presence of wind in the stomach will alone at times give rise to a painful sensation in the region of the heart, and even greatly derange its motions. The sense of pain and spasm in the præcordial region, over the chest and in the arm, together with the absence of all inflammatory symptoms, first suggested the use of the other classes of remedies just named. When opiates are had recourse to, they should be administered in a full dose to give them any chance of being useful. Many practitioners are, however, opposed to their employment—and perhaps with reason in such cases where there is considerable organic disease of the heart. The use of the diffusible stimulants, as ether, ammonia, or champhor,—or of antispasmodics, as castor, valerian, or assafœtida, &c.—is more universally applicable. Hydrocyanic acid, in the dose of a couple of drops, in champhor mixture, or in a solution of assafœtida, is well suited to cases connected with gastric irritation.

In cases where the action of the heart is particularly feeble, stimulant frictions to the back and chest are proper, along with sinapisms, or warm flannels, impregnated with turpentine, over the præcordial region. Stimulating foot-baths and

maniluvia may always be had recourse to, and are peculiarly applicable to those cases where misplaced gout is suspected. A warm aperient or a terebinthinate injection should be administered in the more protracted cases, particularly where the bowels have been previously deranged; and if the stomach has been disordered by the quantity or quality of a previous meal, a mild emetic may be ventured on; or if acidity be complained of, magnesia or an alkaline ought to be given in an aromatic mixture.

In stout and plethoric patients, in whom the pulse is tolerably strong, or where if weak we have reason to think such weakness may depend on the heart and great vessels being gorged with blood, and hence unable to react freely on their contents, cautious venesection is clearly indicated, and has the sanction of Parry, Hosack, Forbes, and other practitioners of high authority. When appropriately employed, it has produced more rapid and striking relief than any other single measure whatever.

In dubious cases, cupping or leeching over the chest or back may be substituted. After the employment of depletion in cases of the kind alluded to, the other remedies mentioned above have appeared of much greater efficacy than when prematurely exhibited. When, however, there is reason to suspect, from the previous history of the case, a passive dilatation of the heart or softening of its walls, we should abstain entirely from all such depletions, as a very slight depressing cause might here suffice to arrest irretrievably the motion of the heart.

In those slighter neuralgic cases where the parietes of the chest seem chiefly implicated, dry cupping and acupuncture are deserving of trial.

As to the treatment in the intervals, no rational plan can be formed without a correct estimate of the morbid elements present in each individual case, and more especially the recognition of organic disease where it exists, the just appreciation of associated disorder in other organs, and an accurate acquaintance with the constitution of the patient, and his habits both of mind and body. Where structural disease of the heart is ascertained as the predisposing cause of the attacks, the treatment appropriate to retarding its increase, reducing the irritability of the system, and improving the general health, of which we shall hereafter have occasion to speak, will of course constitute the most important part of the management of the case, in conjunction with the scrupulous avoidance of all the known exciting causes of the paroxysm, and more especially of all violent exertion of the body, agitating passions, anxiety of mind, intense application to study or business. Many a valuable life has been instantly and prematurely terminated, like that of John Hunter, by a paroxysm of vexation, induced by some lamentably trivial and unworthy cause. The importance of a well-regulated mind, the result of constant moral discipline and of a studied system of self-control, tending to make the patient hang loose to the ordinary passing affairs of life, cannot be too strictly enforced. He should be made clearly to understand, that the prolongation of his life is, in this respect, in a manner in his own hands.

Where the disorder is purely or chiefly neuralgic, or dependent on passive enlargement or debility of the heart's structure, the use of the carbonate of iron or of the protoxide in its nascent state (a most valuable preparation,*) some of the other metallic tonics, as arsenic, or the salts of zinc, silver, or copper, bark, or the sulphate of quinine, especially where the patient has been exposed to malarious influences—together with a nutritious unstimulating diet, regular easy exercise, the enjoyment of a bracing atmosphere, and cheerful recreation of the calmer kind,—are our chief resources. Of exercise the most appropriate is that taken on horseback or in a carriage, fatigue and all undue excitement of the circulation being carefully avoided. The gentle excitement, at once of mind and body, arising from travelling by easy stages, in an interesting country, has often had a very happy influence in this as well as in so many other nervous and spasmodic affections. When the attacks are apt to take place in the night, Heberden's prac-

* For an important paper on the best mode of obtaining and administering this substance, by Mr. Donovan, see *Dublin Med. Journ.* for March, 1840.—AUTHOR.

tice of administering an opiate at bed-time is worthy of imitation. The narcotic alkaloids, both internally and externally, have recently been much extolled; and tincture of iodine, in full doses, is recommended by Dr. Oliver, of Massachusetts.

As derangement of the digestive organs so frequently complicates the other sources of this disorder, and seems not seldom in itself to be a very principal exciting as well as predisposing cause of the paroxysms, it should receive a very ample share of attention in every case where its existence, in any of its varied forms, can be detected. A temperate scale of diet, with great moderation in the use of fluids, and the scrupulous avoidance of every even occasional excess or over-distention of the stomach, together with a total abstinence from wine or other stimulants (at least in the majority of instances;) the regulation of the bowels by the mildest aperients, or still better, if possible, by the quantity of food; the early correction of acidity or other vitiated secretions; the gradual improvement of the tone of the stomach and bowels; and the speedy reduction of all irritation or inflammatory action in the liver, or any other portion of the chylopoietic viscera,—are amongst the most important points in the treatment of such cases.

A gouty or plethoric tendency requires the observance of a system of diet and regimen to be enforced with peculiar strictness; and regular exercise, which in a moderate form is proper in almost every variety of the disease, in order to promote the healthy play of the functions and strengthen the nervous system, without exciting the heart, is here peculiarly called for. The cautious employment of colchicum promises to be occasionally useful; and the importance of the promotion of a free state of the bowels, with attention to the hepatic and urinary secretions, is never to be lost sight of.

Counter-irritation in the form of issues to the thighs, frequently renewed blisters between the shoulders, tartar-emetic ointment, croton oil, a seton or perpetual blister over the region of the heart or in the epigastrium, have sometimes been of peculiar service in the more chronic forms of the affection. The great benefit occasionally observed to ensue, upon the spontaneous occurrence of an hæmorrhoidal discharge, or of ulcers, or eruptions on the extremities or other parts of the body, sufficiently indicates the propriety of establishing such artificial drains or counter-irritations as have just been mentioned, and doubtless first led to their adoption. A very convenient form of establishing a purulent discharge in such cases, employed by Dr. Hutchinson, as mentioned by Dr. Copland, consists in the application to the skin of the bark of mezereon root, soaked in water and deprived of its external cuticles, and retained in contact with the skin, by means of a large patch of adhesive plaster. It must be renewed for a day or two, till the purulent secretion is established, and this may subsequently be maintained for such a period as is desirable by the occasional reapplication of the bark. M. Richard, we find, mentions other species of *Daphne*, which, after maceration in vinegar, are similarly employed by the people in France, and some more southern countries. The application, he adds, sometimes excites an inconvenient degree of itchiness and irritation, with crops of pustules, rendering frequent tepid ablutions, with water or a decoction of marsh-mallows, necessary.

We have known a belladonna plaster over the præcordial region, renewed every week or ten days at farthest, to procure very considerable alleviation of the attacks.

Respect for the name of Laennec induces us to state, before quitting this subject, that he had great faith in the application of a couple of magnetized steel plates, one over the heart, and the other with its pole opposite to it on the back, so placed with a view to causing the magnetic current to pass directly through the suffering organ. Whether the beneficial influence of this arrangement, which he states he had frequently witnessed, was not in a greater degree dependent on the reaction of the imagination of the patient on his nervous system, than on any direct magnetic agency operating on the cardiac and associated nerves, we shall not take upon ourselves to decide. Its good effects seemed occasionally to have been promoted, as we can well believe, by applying a small blister under the anterior plate.

NEURALGIA OF THE HEART.

Symptoms.—Nature.—Treatment.

UNDER this title has been described, by Dr. Elliotson and other recent authors, an acutely painful, intermittent affection of the heart, obviously of a nervous character, which seems to differ from angina more in respect to the small number of parts which are drawn into morbid consent with the suffering cardiac nerves, than in regard either to its nature or appropriate treatment. It consists in an acute lancinating pain, often of great intensity, darting through the præcordium from before backwards, and coming out under the left shoulder. It is ordinarily confined to the heart itself, the respiratory system continuing quite unaffected. Those cases in which the pain extends to the left arm and side of the neck, and still more those in which the parietes of the chest are implicated, must be referred to the head of angina.

Intermediate cases, it must be confessed, present themselves in practice and baffle classification. It is of pure neuralgia of the heart, however, that we mean here to speak, or that condition which involves the sensitive function of the cardiac nerves alone. The sounds and motions of the organ are here commonly little or not at all affected, though this is not invariably the case. The attacks recur often, without any apparently adequate exciting cause, and, unlike angina in its early stages, even when the individual is quite at rest. The intervals are various, being sometimes only of a few hours' duration, and sometimes of many days. Like other neuralgic affections, it occasionally manifests a tendency to periodicity; and when the acute pain of the attack has diminished, it frequently leaves behind, for a considerable time after, an uneasiness or dull aching in the region of the heart. The anguish in the more exquisite form of the disorder is, during the seizure, often quite overpowering. In its inferior grades, however, it is merely like a stitch, or crampish pain, seeming for an instant to take away the breath, and followed by a quick forced sigh or sob: in this latter degree it is by no means an uncommon occurrence, and is one apparently of little importance, being, like other pains of a nervous character, frequently merely the result of sympathy with the stomach when distended by flatulence or irritated by acidity, though at other times it seems to be connected with over-distention of the vascular system. The duration of this complaint is quite uncertain, as it sometimes continues to recur for years in spite of all treatment. It appears most frequently to originate under the influence of long-continued over-exertion of mind or anxiety acting on an irritable and nervous temperament, and is sometimes connected with a rheumatic or gouty tendency. A malarious source has been, in some cases, and apparently with reason, suspected. The upper part of the spine should in every case be carefully examined, as a very similar pain may arise from irritation or disease within the vertebral canal. The excessive use of strong tea, in certain idiosyncrasies, is occasionally, and not unfrequently we believe, the unsuspected cause of acute pain in the region of the heart, together with a sense of faintness and impending syncope, of which a well-marked instance has been recorded by Dr. Edward Perceval. (*Dub. Hosp. Rep.*, vol. i.)

Treatment. Most of what has been said in respect to the treatment of angina pectoris is equally applicable to this more limited affection. As, however, it seems much less commonly to be complicated with structural disease of the heart, narcotics both externally and internally may be more freely employed, as for example, opium in combination with camphor, or fractional doses of the narcotic

alcaloids, the salts of morphia, hydrocyanic acid, &c. Ether, ammonia, and other stimulants, along with anti-spasmodics, may likewise be had recourse to, in order to procure relief during the paroxysm. Some of the more speedy forms of counter-irritation, as by means of mustard, ammonia, or turpentine, or the local application of heat in a degree sufficient to redden or even slightly blister the skin, in the manner alluded to in the last section, should also be immediately put in practice. In the intervals a belladonna plaster should be worn, or an ointment containing veratria employed. Where these fail, as will too often be the case, we must have recourse to some of the permanent forms of counter-irritation spoken of in a previous page, and persevere steadily in their use for a very considerable period; whilst we endeavour simultaneously to regulate the action of the bowels, and to give tone to the stomach and system generally, as it is by such means, more, perhaps, than all others put together, that the tendency to neuralgic affections is most frequently and permanently removed.

The empirical use of purgatives has, in some rare instances, been crowned with complete success; and the trial of a mild mercurial course is justifiable in cases which have resisted other methods of treatment. When a rheumatic, malarious, or gouty origin is suspected, the treatment should be modified in reference to it. Quinine, Fowler's solution, colchicum, turpentine, hydriodate of potass or of iron, the carbonate of iron, and nitrate of silver, have all severally appeared useful in different instances. The disease, however, is in many cases so obstinate, that we run through all our resources in vain, and are fain at length to resign it to its course and to the slow influences of time and gradual change of constitution. Great temperance in food, and abstinence from all stimulant beverages, especially malt liquors, suit best with the majority of cases; some, however, have, on the contrary, gone on better on a fuller diet, and a moderate use of wine; whilst change of air, cheerful recreation, and regular exercise, have appeared beneficially applicable to all.

PERICARDITIS,

OR INFLAMMATION OF THE EXTERNAL MEMBRANE OF THE HEART.

Anatomical characters.—Symptoms.—Physical signs.—Frequency.—Chronic Pericarditis.—Duration.—Complications.—Prognosis.—Diagnosis.—Causes.—Treatment.

INFLAMMATION of the external serous covering of the heart, and of the sero-fibrous sac in which the organ is enclosed, the symptoms of which were reckoned so obscure by Corvisart and Bayle, and even by Laennec, has become, since the publication of a valuable memoir on the subject, by M. Louis, a few years ago, much better understood, more easily recognised, and consequently more susceptible of successful treatment. As some of the most important of the phenomena by which its presence is discovered are of a physical kind, and as the mode of their production cannot be comprehended without a previous knowledge of the anatomical changes in which they originate, we shall commence with an account of the morbid appearances usually characterizing this affection.

Anatomical characters. Inflammation of the pericardium, like that of other serous textures, is characterized by redness, and by effusion of coagulable lymph, and of a fluid generally of a serous nature, but varying somewhat in its appearance and composition. The redness, which may depend either on injec-

tion of the capillaries, or on the effusion of blood into the sub-serous tissue, and the subsequent infiltration from that source of the serous membrane itself, assumes various forms, dotted or mottled, in stripes, or patches, or widely diffused. Yet sometimes, where the case has terminated fatally while the inflammation of the part was still in its nascent state, no redness has been found after death; probably rather, as in the parallel case of erysipelas, in consequence of the dilatation of the minute vessels not having been sufficiently long in existence permanently to overcome their contractility, than from the actual absence of such redness during life. The membrane itself is rarely notably changed either in respect to thickness or transparency, the appearances which have sometimes been mistaken for such alterations being really produced by the presence of a closely adhering false membrane. In the very earliest stage the serous membrane has been thought to be somewhat drier and less polished and slippery than natural; and at a more advanced period it becomes more easily detached from the heart than it should be.

The coagulable lymph, which is partly secreted in that form, and partly a deposition from the effused serum, exists in very various quantities, sometimes covering the whole pericardium in the entire of its opposed surfaces, and sometimes confined to a limited portion of it, dispersed at times in irregular masses, but more commonly expanded in a membranous form, and varying in thickness from the fraction of a line to several lines. The unattached surface of the false membrane thus originating differs somewhat in its external appearance from that observed on other serous membranes, in consequence of the perpetual movement of the contained organ and the incessant change of relation between the opposing surfaces of the pericardium. It has thus often an irregular areolated appearance, alternately compared, according to its degree of fineness or coarseness, to the reticulations of a sponge, to the cells of a honey-comb, or those in the interior of the second stomach of the cow. At other times its surface, tuberculated or studded over with slight prominences, has caused it to be likened to the exterior of a pine-apple; or, if more jagged and irregular, to the appearance produced on separating two plates between which, butter of a soft consistence had been compressed. The false membrane may present, moreover, a rough and shaggy appearance, from being thickly covered over with flocculent shreds, or when it has been some time secreted it may be arranged in undulating furrows or wrinkles. Where recently poured out, it is of a pale yellow colour and soft texture, like the buff or inflammatory crust of the blood, but becomes gradually firmer with time. Occasionally it has a reddish tinge, especially when any blood has been effused into the pericardium, and when organization is commencing.

Sometimes it presents the appearance of a succession of layers, ascribable to the repeated recurrence of the inflammatory process; at others the whole pericardium is strewed over with minute, softish, albuminous granulations. Where the lymph is not early absorbed, adhesions commonly take place between the opposing surfaces (if not prevented by the quantity of serum present,) and thus all farther continuance of the morbid effusion may be prevented, and the progress of the disease arrested—too often, however, the truce is only temporary, being succeeded, in consequence of the shrinking and condensation of the organized adhesions, by subsequent limitation and embarrassment of the heart's movements, and eventually by morbid alterations in its parietes or internal structure. It is only where the early and active interposition of art, or the salutary efforts of nature have cut short the disease in its very origin, or led to the speedy absorption of the plastic matter, as well as of the accompanying liquid effusion, that both sets of evil consequences, the immediate and the remote, are with certainty escaped from. That such a result is attainable—nay, even in a great proportion of cases actually obtained—we have evidence in the frequency with which slight traces of old pericardial inflammation are met with on dissection, though no permanent disorder of the heart's action had existed during life, nor was any other alteration of its structure discoverable after death. The white spots or patches

of condensed cellular membrane, so often observed on the free surface of the pericardium, and which may, with care, commonly be dissected off, are instances of such partial and passing inflammations; as are likewise those in its sub-serous cellular tissue, which, according to Dr. Hodgkin, are by no means of rare occurrence. Where adhesions take place, the lymph soon becomes organized and converted into cellular tissue of various degrees of firmness and condensation; and such adhesions may ensue, as has been shown by Dr. Copland, though the lymph should originally have been effused only on one of the opposing surfaces of the pericardium, as by contact the inflammatory action is soon excited on the other. The rapidity with which the process of secretion and incipient organization occasionally takes place in pericarditis is very striking. Where the inflammation has run very high, sometimes the external surface of the sac throws out lymph, and becomes adherent to the adjacent pleuræ.

In old cases the connexion between the bag of the pericardium and the heart is often very close, and it is such instances which have probably occasionally been described by the older pathologists erroneously as examples of congenital absence of this membrane. Where the agglutination takes place in an early stage of the disease, and whilst the contractions of the heart still retain a considerable portion of their vigour, the lymph, being as yet recent and ductile, is readily drawn out into long strings or loose adhesions, which do not so materially impede the future movements of the organ. The closest and most unyielding ones, on the contrary, were thought by Laennec to be peculiar to the more chronic cases of the disease, in which the adhesions were, by the presence of fluid, long prevented from taking place, so that the effused lymph had, previously to such union, acquired a considerable degree of firmness and density. This, however, is not in conformity with the experience of Dr. Hope, who thinks he has observed these intimate adhesions to be the result more frequently of the more acute forms of inflammation.

The liquid effusion of pericarditis in its earlier stages differs from that of hydro-pericardium, afterwards to be mentioned, in deviating more in its composition and appearance from the natural serous fluid, being a mixture of this with coagulated lymph, and sometimes with pus, or more rarely with blood. It is hence of various colours, more commonly of a pale greenish or yellowish hue, or a mixture of both, and has its transparency often considerably impaired by the flakes and shreds of coagulable lymph which float through it. If this latter substance be in a very subdivided form, it gives to the liquid a whey-like appearance, or even a milky opalescence. In respect to quantity, if unfortunately the patient's death affords an opportunity of examining the fluid within the first few days of the disease, it rarely falls short of eight or nine ounces, and has been known to amount to so much as three or four pounds. As the inflammatory action begins to diminish, the process of absorption resumes its activity, and very quickly reduces the superabundant fluid, so that the coagulable lymph now comes to predominate. In some rare cases connected with previous disorder of the general health, purulent matter is secreted from the first, and almost without any traces of coagulable lymph; but more commonly it is at a later period that the formation of pus commences, namely, in that more advanced stage of the inflammation where, from the neglect or the inadequacy of treatment, it threatens to pass into the chronic stage, and where neither the absorption of the early effusion nor yet the salutary adhesion of the plastic coating has been effected. Of thirty-seven cases analyzed by Louis, the effusion was sero-sanguinolent in five, entirely serous in nine, sero-purulent in fifteen, and true pus in seven. Where the tendency to suppuration predominates over that to the formation of coagulable lymph, the effused fluid is of a more uniform and creamy consistence.

Where pericarditis occurs in a chronic form, the redness is less vivid than in the acute, but the larger vascular ramifications from which the inflamed capillaries arise are commonly more developed. The long continued pressure of the effused fluid seems materially to interfere with the vigour of the heart's pulsations, the organ

having from this cause often a wasted, as well as a whitish and macerated, appearance; though this is still more common in Hydrops pericardii, in which the liquid is thin and serous. Even in the chronic stage there is still a possibility of the fluid being absorbed and adhesions taking place, though the chances of such a termination are very much less considerable than in the acuter form, both on account of the nature of the effusion, the local condition of the parts, and the deeply deranged state of the general health which is commonly induced. The formation of adhesions, however, though to a certain degree protective, does not absolutely preclude the recurrence of inflammation in the false membranes; and the chronic form of the disease may from time to time give place to more acute attacks, which materially accelerate the approach of the fatal termination. In some instances, small collections of purulent matter are met with in the interstices of the adventitious membranes; and in strumous subjects they occasionally, though rarely, become the seat of tubercular deposition, just as has been observed in the parallel cases of inflammation of the peritoneum and pleuræ, occurring in connexion with a scrofulous tendency.

A slight degree of thickening may take place in the pericardium from chronic inflammation; where, however, this appears to amount to any thing considerable, an attentive examination will generally show that the change is extrinsic to it, and either seated in the sub-serous cellular substance, which has become hypertrophied, or that it depends on the organization of very closely adherent, equally distributed, and smooth false membranes on its secreting surface.

The false membranes of pericarditis may eventually not only become very dense cellular tissue, but even pass into a state of fibro-cartilage or bone. M. Louis has recorded a case of the latter kind where the base of the heart was surmounted by a broad osseous zone; and Burns, Laennec, Bertin, Adams, Smith, and others, have met with similar instances.

Where the quantity of organized coagulable lymph is very considerable, its effects may be, like those from the compression by a fluid, previously alluded to, to induce atrophy of the organ; but much more commonly, by exciting its action, they give rise to the very opposite condition, that of excessive nutrition and inordinate enlargement.

The inflammatory action sometimes seems to extend its influence to the superficial fibres of the heart itself, as is manifested in the softening and increased friability of the muscular tissue, its colour being either deepened into a reddish-brown tint, or in more chronic cases diminished to a pallid yellowish hue. More rarely the heart undergoes an increase of density.

Symptoms. The functional derangements in these cases are variable, and in their ordinary combinations, far from sufficient, at least without the aid of the physical signs, for the confident recognition of the disease. Amongst those most commonly present are high fever generally preceded by rigours, pain in the region of the heart, irregularity of pulse, and palpitations, dyspnoea, anxiety, restlessness, and incapacity of lying on the left side, and a peculiar expression of countenance indicative of great distress. More rarely there is cough, vomiting, and difficulty of swallowing. As the disease advances there is extreme debility, suffocative paroxysms, and occasionally a tendency to syncope, with infiltrations of the face, or extremities, or both.

The blood drawn exhibits the appearances characteristic of inflammation in the highest degree, being cupped and buffed, with a very firm coagulum. The pulse in some rare cases is at first unaffected, or, according to Dr. Williams, sometimes slower than natural. The irregularity or intermission often affords the earliest notice of the impending disease, though most commonly these peculiarities of action do not manifest themselves till a more advanced period. The fever, indeed, presents itself in a great variety of forms. The pulsations at the wrist, towards the commencement more especially, are ordinarily frequent, full, strong, and regular, along with a hot and sometimes a moist skin; or they may be hard and jerking, along with violent impulse of the heart; or, again, small and wiry,

and quite at variance, as it were, with the strong action going on in the præcordial region. At other times, and more especially at a somewhat advanced stage of the affection, the pulse is small and weak, uneven and irregular, the cutaneous surface being at the same time either dry and hot, or, more usually, cold and damp, especially in the extremities. The face may be flushed, and swollen, or pallid, haggard, and bathed in perspiration, and expressive of intense anxiety or anguish; and when the distressing sensations reach their acme, there is often incessant jactitation, and uneasiness in every posture.

The pain in the region of the heart is increased by pressure upon or between the corresponding cartilages of the ribs, or in the epigastrium, especially when directed upwards, towards that portion of the diaphragm on which the heart rests. The pain occasionally shoots outwards towards the back, and upwards towards the shoulder, and thence into the arm to near the elbow. It is very various in intensity, being in some instances so excruciating, as in the case of the celebrated Mirabeau, as to cause the sufferer to look anxiously for death as a deliverance; whilst in others, on the contrary, it is scarcely, if at all, complained of, save whilst pressure is being made in the regions just indicated.

By very many patients the pain is referred to the epigastrium or left hypochondrium, much more than to the præcordial region. Mr. Mayne, in his admirable account of this disease, states that it existed in the first of these situations, in ten cases out of the eleven analyzed by him: it was ordinarily exasperated by upward pressure, and was more circumscribed than that which occurs in connexion with inflammation within the abdomen; and there was commonly less disturbance of stomach, though there were some instances where this was rather a prominent symptom. In some cases a sense of constriction all over the left side of the chest, or a feeling of weight in the region of the heart, has been complained of, rather than actual pain. Pain, in some form or other, is certainly present in the great majority of cases.*† It may be of a burning, lancinating, or a stitch-like character, as in pleurisy; and is often increased by full inspiration or coughing, as well as by extending, or lying on the left side. The decubitus on the back is generally preferred in the earlier stages. Where severe inflammation of the pleuræ, or acute rheumatism of the joints, precedes or accompanies it, the pain in the cardiac region may be so much thrown into the shade as to be readily overlooked. It was, however, in the simplest cases, that is, where there was neither pleurisy, nor pneumonia, that Laennec says he had observed this symptom to be most frequently wanting; these being the instances, too, in which the affection was most apt to remain latent.

Palpitations and irregularity of the pulse are likewise amongst the more frequent symptoms; but as they are of an intermittent nature, it is often necessary, in order to detect them, to examine the patient very frequently, even within the course of a single day. They are commonly greatly exasperated by the slightest movement of the body, by coughing, or speaking, and are sometimes only perceivable after such exertions. The action of the heart, which is ordinarily so vehement at the commencement, subsequently appears unusually weak when removed from contact with the chest by a profuse effusion; and its impulse is no longer confined to a single point, but may sometimes be felt in successive moments in different parts of the præcordial region.

The respiration is often short and laborious, and occasionally interrupted by sighs or hiccup, especially when the inflammation has extended to the surface of the diaphragm, in which cases likewise the risus sardonicus has sometimes been observed. The difficulty of breathing is accompanied moreover by a peculiarly

* Chomel, after dwelling strongly on the circumstance of pain being much more frequently absent here than in any other inflammations, strangely adds that its intensity, where present, is rarely, if ever, augmented by pressure. (*Dict. de Med.*)—AUTHOR.

† This is questionable: I should say it was more frequently absent than present, and very often is quite insignificant. G.

deep expression of anxiety, and, when the case is very severe, and especially if a fatal termination impends, amounts to orthopnœa. Where the dyspnœa comes on suddenly, and without any discoverable disease in the lung or its lining membrane, it is a symptom of great value. "Some feeling of dyspnœa, or faintness," says Dr. Williams, "especially on moving, is the most constant symptom, and this is generally accompanied by irregularity of the pulse. The contractility of the heart, which was, in the first instance, exalted by the inflammation of its membranes, ultimately becomes impaired, the action loses its rhythm, becomes sometimes palpitating, sometimes defective, and verges on syncope." Yet the actual occurrence of syncope appears, from the researches of Louis, to be much rarer than has been commonly apprehended; and a reference to the cases recorded by Corvisart, Bertin, and Andral, proves it to be decidedly an infrequent symptom. The posture oftenest preferred by the sufferer, in the advanced stage, where the distress is extreme, is the sitting one, with the body leaning somewhat forward, or to the left side, as it were, to relax the inflamed membrane.

The brain here often sympathizes deeply with the derangement of the heart's functions, as is manifested by the sudden starting from sleep in affright; and at other times by the supervention of delirium and total loss of rest, and occasionally by the occurrence of spasmodic twitches, or even general attacks of convulsions. Yet such violent symptoms of reaction are by no means universal; the constitutional sympathy being sometimes incredibly slight, a very inconsiderable degree of oppression having occasionally been alone complained of.

Infiltration of the extremities is more peculiarly, though not exclusively met with in the more chronic cases; and is often associated with a pallid or livid, and occasionally a puffy, state of the face, especially the eyelids and lips, all of which are indicative of a high degree of obstruction to the course of the circulation.

It has been remarked by M. Bouillaud that the cases of the greatest suffering, both general and local, are those of pleuritic complication, and especially where that portion of the pleuræ which lines the diaphragm is affected; and he adds, that in those cases where there is an extreme sense of suffocation and tendency to syncope, there commonly exists an abundant effusion into the pleuræ as well as into the pericardium, and sometimes also polypous concretions within the heart.

Sympathetic vomiting is one of the symptoms of nervous disturbance which sometimes makes its appearance, more especially in connexion with inflammation of the upper surface of the diaphragm; and though doubtless ascribable in some instances to the vicinity of the peritonæum and stomach, to the inflamed pericardium and pleuræ, and the propagation of the inflammatory action, yet in others again it has probably its origin solely in the connexion of the nerves of those parts. Pain and difficulty of swallowing, apparently also of sympathetic origin, have been noticed in a few cases by Testa and others. Dr. Stokes, who has recalled attention to this fact, adds, that he has known the same symptom to occur in connexion likewise with inflammation of the lungs and pleuræ; and that aphonia, moreover, has occasionally presented itself under similar circumstances; and that he once observed very notable changes in the character of the voice to accompany the several stages of a pericarditis. He inclines strongly to the opinion that these phenomena are rather of vital than mechanical origin, inasmuch as, in the cases in which they were met with, there was no very considerable degree of effusion, nor, consequently, of pressure; whilst, on the other hand, they have been absent where the heart and lungs have been most remarkably displaced and compressed by the existence of fluid in large quantity in the pleura and pericardium simultaneously.

The great dissimilarity of the symptoms in different cases as well as their variability in the same case, are very remarkable features of this affection, and may, in some degree, be explained by a reference to the varieties of pathological condition which exist, and more especially in regard to the effusion, its quantity and

nature. Thus, as Dr. Hope and Dr. Stokes have remarked, if this consists almost wholly of coagulable lymph throughout, or if the serum thrown out have been rapidly absorbed and adhesions been early effected, the circulation will be less interfered with, and less suffering will be produced than in those other more formidable cases where there is a copious fluid effusion painfully distending the inflamed membrane, pressing upon the heart, embarrassing its motions, and inducing weakness and irregularity of the pulse, faintness, anxiety, and a sense of suffocation, along with coldness and lividity, and incapacity of assuming the recumbent posture. The supervention of such a group of symptoms at any period of a case indicates a very serious aggravation of the state of the local affection. Yet even the effusion of coagulable lymph alone, if in extraordinary quantity, may perhaps occasionally be their source; as may likewise the coming on of inflammation in the muscular substance of the heart. The degree of morbid alteration requisite in any of these cases to effect a certain amount of disturbance will, of course, vary with the nervous irritability of the individual. The cases in which the disease may be most readily altogether overlooked, are those where the effusion is confined to coagulable lymph, and where this exists only in very small quantity. (*Stokes.*)

Physical signs. The impulse of the heart at the commencement is ordinarily much augmented and abrupt, accounting for that throbbing or jerking character of the pulse which has been noticed.

The sounds are likewise increased in intensity, and, when endocarditis co-exists, as is so often the case, are accompanied by a bellows-murmur. Very early in the course of the disease, as on the second or third day for instance, a faint *rubbing* or *rustling sound* (*bruit de frottement*, or to-and-fro sound—murmur of ascent and descent, &c.,) such as that produced by the friction of silk-paper or parchment, is frequently audible, accompanying both sounds of the heart. This is most commonly first heard near the centre of the sternum, a little to the left of the mesial line, that is over against the base of the heart. It gradually assumes a louder, rougher character, and generally extends eventually over the whole region of the heart, and materially obscures the natural sounds of the organ, though they may still be recognised by applying the stethoscope near the top of the sternum. It has its source in the friction of the opposed surfaces of the effused lymph, which, even whilst still very thinly spread and soft, is quite sufficient for its production, as has been fully ascertained by the experiments of Drs. Williams, Clendinning, and Todd. Whether the first stage, or that of simple congestion and dryness of the membrane, be capable of giving rise to it, in a minor degree, is still doubtful: the experiments of the gentlemen just named render it, indeed, very improbable that it is ever heard except in those cases where ecchymosis under the pericardium, or some slight traces of coagulable lymph on its polished surface, already exist.

The rubbing sound occasionally somewhat changes its character, and becomes perfectly similar to the creaking of leather in the sole of a new shoe or saddle (*cris de cuir—leather creak.*) This was first observed by M. Collin; and though Laennec was latterly skeptical as to its import or reality, it has since been fully confirmed as a valuable sign of pericarditis by Stokes, Reynaud, Watson, Mayne, Bouillaud, Williams, and others. Dr. Copland has likewise noticed it, but thinks that it occurs chiefly in the chronic stage of the disease, and that it is dependent on thickening and induration of the pericardium and connecting cellular membrane; or else upon the existence of a dense and elastic false membrane. Many distinguished pathologists have failed in detecting it,—probably, in part, from having confounded it with the sounds of valvular disease, and partly, as suggested by Mr. Mayne, from their not having had an opportunity of examining the cases early or frequently enough. Its whole duration sometimes does not exceed a few hours, as it is necessarily put an end to, either by the absorption of the coagulable lymph, or the formation of adhesions, or what is more frequently the case, by the effusion of fluid in sufficient quantity to keep the opposed sur-

faces apart. When the formation of adhesions is the cause of its cessation, we shall probably have neither that irregularity or sinking of the pulse, nor that prostration of strength, occurring in cases of large and rapid liquid effusion; whilst, at the same time, the sound elicited by percussion is clear, and the impulse is strong. The rubbing sound will, in these cases, continue to be heard longest, as Dr. Williams suggests, towards the apex of the organ; whilst in those instances, on the contrary, where it disappears in consequence of the pouring out of an abundant quantity of fluid, it persists longest towards the base: in the latter cases, too, it may sometimes be momentarily reproduced by leaning the body forward, and so bringing the heart in contact with the interior surface of its investing sac. This distinguished physician has known this sound to continue, in a few instances, for no less than a fortnight, in conjunction with the signs of a moderate effusion of fluid. The diminution of the heart's action, which is so conspicuous in the third stage of the disease, seems likewise to be sometimes concerned in the cessation of the sound in question, for it continues occasionally to recur at intervals with each casually stronger beat. As absorption makes progress, it has sometimes also been known to reappear. The sensation of friction is in some well-marked cases imparted very distinctly to the touch as well as to the ear.

The peculiar sound in question is commonly distinguishable from that connected with valvular disease, as Dr. Stokes many years ago pointed out, by the suddenness of its occurrence, and by the short distance from the cardiac region within which it is audible, as well as by the greater influence of treatment over it. But still there may be considerable difficulty of diagnosis where disease of the valves has pre-existed, or where endocarditis springs up simultaneously. The rubbing sound is, however, of a decidedly more superficial and equably diffused character than the bellows-murmur, indicative of disease of the valves and orifices; and is more constantly double, or an accompaniment of both motions of the heart.

The impulse of the heart decreases with the progress of the increasing effusion: the sounds likewise, both natural and morbid, become feebler and more distant, but may still be heard distinctly at the top of the sternum, or root of the neck, in the course of the great arteries emerging from the chest, being conveyed thither through the intervening solids, and with the arterial current.

Inspection and measurement of the chest often detect, as Louis has pointed out, a fulness of the left side under the lower part of the sternum in the region of the heart, caused by the effusion within the pericardium, and partly, perhaps, also by the increased afflux of blood to the inflamed organ; and in chronic cases, or where close adhesions have taken place, by the incipient hypertrophy of its muscular parietes induced thereby. This appearance of prominence will naturally be most conspicuous in subjects of tender age, in whom the cartilages are most flexible and yielding.

Very soon after the commencement of the disease, a dull sound is elicited on percussion, in the situation just spoken of, the extent of which, as compared with the natural limits of deficiency of sound in the cardiac region formerly alluded to, very accurately defines, in simple cases, the degree of the effusion. The extent of this dulness where the quantity of fluid poured out is profuse, may be very considerable; occupying even the greater portion of the left side of the chest, and extending moreover a little to the right of the sternum. We must not, however, expect to meet with it in a marked degree, if at all, in the earliest stage of the disease, any more than the prominence above alluded to; and in those cases where the morbid secretion is limited to coagulable lymph, and that perhaps in small quantity, or where the fluid effusion is throughout very inconsiderable, the dulness may never be very obvious.

Where, however, the quantity of effusion amounts to nine or ten ounces,—and it commonly much exceeds this,—the results of percussion will be usually very important, if not altogether decisive. Our conclusions may sometimes, indeed, be embarrassed by the existence of pleurisy, or pleuro-pneumonia of the left or

of both sides. When, however, these affections are confined to the right side, percussion is still capable of aiding in the recognition of pericarditis; and M. Louis has shown that in at least one-half of the cases which occur it affords conclusive indications. Besides, it is to be added that the existence of dulness in the præcordial region, even though it should not be confined to that spot, is a valuable fact, inasmuch as it naturally leads to a closer investigation of the functions of the heart, and thus there is commonly disclosed sufficient evidence of pericardial inflammation where it really exists. In uncomplicated cases, again, the reality of its presence, being rendered probable by symptoms, may be confirmed materially by the disproof of all disease of the lung and its covering. If, on the contrary, the pericardial inflammation should unfortunately be masked by the predominance of an acute pulmonary affection, the error in regard to the treatment, at least, is not of very material consequence.

The sitting posture is one of those which afford the greatest facility for detecting the presence of a fluid within the pericardium: when the patient is lying on his back, on the contrary, its gravitation towards the posterior part of the chest may cause it, if small in quantity, to elude observation. The effect of the change from one to the other of these postures may assist us in discriminating pericardial effusion from a circumscribed pleuritic effusion in the same neighbourhood, tumours in the anterior mediastinum, &c. For some additional remarks on this subject, the reader is referred to what is said on percussion in the article **HYDROPERICARDIUM**.

The existence of false membranes and of adhesions after all inflammatory action has ceased is commonly very difficult of detection. The presence of the creaking or leather sound has occasionally led to their recognition; whilst a harsh grating sound has indicated a rougher or ossific state of the outer lining of the heart. Dr. Williams tells us he has sought in vain for "the jogging or tumbling motion" said by Dr. Hope to be characteristic of this restrained state of the organ; but adds, that when the inflammation has extended through to the exterior surface of the sac, and caused its agglutination to the walls of the chest, the motions of the organ become much more plainly and widely felt than usual, drawing in the intercostal spaces at each systole. The nature of the case may sometimes also be suspected by observing that change of position has no influence over the extent in which the pulsations and the dulness on percussion are perceptible. It must be admitted, however, that a similar permanency in respect to these circumstances exists also in cases of very great enlargement of the heart.

In cases of very close adhesion, each contraction of the ventricles has been observed by Dr. Sanders to be accompanied by a corresponding retraction of the left portion of the epigastric region; and Dr. Copland has verified this symptom in two or three instances; yet it must needs be rare, or very obscure, as Laennec, Hope, Bouillaud and Chomel, have sought for it unsuccessfully.

Much difference of opinion has prevailed as to the influence of intimate adhesions on the future health, and on the action of the heart in particular. Corvisart believed that extensive adhesion necessarily deranged the motions of the heart and diaphragm so materially, as to lead sooner or later to a fatal termination, and Dr. Hope takes scarcely a more favourable view, believing that where the adhesions are close and universal the incessant struggle and over-distention of the heart, together with the alteration induced in its texture by the previous inflammatory action, tend invariably to cause enlargement of the organ, and, after an indefinite interval of a very few years, death is the almost constant result. Such patients commonly labour, ever after the original attack, under a certain degree of dyspnoea and inability to undergo the same exertions as formerly. Laennec, Chomel, and Bouillaud on the contrary think such adhesions often unimportant; and Elliotson says they do not in general produce the slightest inconvenience unless where organic disease of the heart co-exists. Bouillaud believes moreover that the hypertrophy of the heart, and other formidable consequences usually ascribed to them, are referrible with much more probability to the organization of lymph effused

within the cavities of the heart, and other co-existing results of endocarditis, a disease which as is now well known often complicates pericarditis. For our part, however, it seems difficult to believe that so unnaturally shackled a condition of so mobile an organ should not very generally lead to farther lesions as it is obvious that its increased action must powerfully promote the development of any morbid tendency inherent in it. Dr. Hope has observed that the heart, though enlarged, did not in these cases beat lower in the chest than natural, but sometimes occasioned a manifest prominence of the cartilages of the left ribs, both of which circumstances result obviously from its adhesions preventing its enlargement downwards or the descent of its apex.

CHRONIC PERICARDITIS is generally only the sequela of the acute variety. Occasionally, however, pericarditis assumes the chronic form from the very commencement, being unattended with any marked degree of fever, whilst the local symptoms are so mild as scarcely to attract notice. In such cases it is often altogether latent;—frequently, however, rather from attention not being particularly called to the seat of the diseased action than from the absence of sufficiently characteristic symptoms. Thus, if in addition to the physical signs indicative of effusion, as dulness on percussion, undulatory impulse, distance of the heart's sounds, and prominence of the præcordial region, there be some degree of pain or uneasiness in the situation of the heart, a slow fever with or without exacerbations in the evening, a general sense of oppression and debility, slight œdema of the face (which part is occasionally also of a violet tinge,) and œdema of the ankles, we shall have reason to apprehend the existence of chronic pericarditis. The cause to which the indisposition is ascribed, as a fall or blow, acute rheumatism or inflammation within the chest, may throw farther light on the nature of the affection. The comparative recentness of the disorder, which commonly does not date farther back than a few weeks or months, taken in connexion with the advanced state of the dropsical symptoms, will aid us in distinguishing it from the results of old organic disease of the valves and orifices.

Frequency. Pericarditis is a disease of rather frequent occurrence. Louis recognised its existence on an average at the rate of four per cent. of all the dissections witnessed by him within a given time.

Though an affection of the most serious nature, it is, as already stated, now ascertained to be much less commonly mortal than it was within these few years generally supposed to be. From an estimate of the number of times that traces of it are met with in the bodies of those who have died of other diseases, Chomel is led to conclude that it does not prove fatal in above a fourth (Louis says a sixth, if uncomplicated) of all the cases in which it occurs, and even these averages are probably rather over than under the truth, as they take no account of those instances, probably not very rare, in which the disease being cut short in its earliest stages, or the absorption of all effused matters being complete, no permanent traces of its existence are left behind. Of the cases in which death takes place in the course of the disease, the fatal event is ascribable, in at least one half, to co-existing complications. Where very acute, it has been known to prove fatal within thirty hours from its commencement, but this is very rare.

Its ordinary *duration*, if acute, is, unless very actively treated, from one to two weeks; or, if sub-acute, three or four, within which periods it terminates in death or recovery, or else begins to assume the features of the chronic stage.

The *prognosis* becomes much more unfavourable where a large effusion of fluid has taken place, and this in proportion partly to the rapidity with which it is thrown out; so, likewise, where œdematous swellings of the extremities make their appearance, where the action of the heart is greatly disturbed or oppressed, where the inner lining of the heart is deeply implicated, where there existed previous organic disease of the organ, or serious inflammatory complications, more especially in the lungs or pleuræ, and finally where the constitution has long been in a cachectic or debilitated condition.

Complications. Of all these complications, especially where the disease is of

rheumatic origin, which is the case perhaps in three out of every four instances, endocarditis is the most frequent. It is indeed rarely altogether absent, and is recognised by the bellows murmur and other signs to be enumerated in a subsequent section. Pericarditis seems more frequently to excite, than to ensue upon, inflammation of the interior of the heart. Pleurisy or pneumonia are present in the greater number of instances; Louis supposes in at least two-thirds of the whole; carditis, or superficial inflammation of the muscular structure of the heart, and a similar condition of the cellular membrane in the anterior mediastinum of the upper surface of the diaphragm, or of the peritoneum, liver, or other abdominal organs, occasionally co-exists. The occurrence of cerebral excitement is, as we have already seen, not unusual. Pericarditis frequently makes its appearance in connexion with the eruptive fevers, and more especially with scarlatina. In childhood, too, it forms, no less than in adult life, a very ordinary complication of acute rheumatism, and often originates in the course of neglected convalescence from various acute diseases, especially, as Dr. Copland remarks, amongst the children of the poor living in damp habitations and debilitated by insufficient nutriment.

Death by syncope is a possible but certainly rather an unusual *termination* of pericarditis. Extreme dyspnœa, amounting almost to suffocation, is, towards the conclusion, the prominent symptom in most of the fatal cases. By much the most unfavourable examples of the disease, and the least capable of bearing the requisite treatment, are those occurring in patients debilitated by previous illnesses, as fever, dropsy, &c.

Relapses are common even in cases of the disease which have been actively and judiciously treated; as is likewise the recurrence of inflammation in the membrane at periods long subsequent, and especially where the organ which it envelopes is the seat of structural change. Even adhesions do not, as commonly supposed, confer absolute immunity from future attacks; for there has often been observed by Dr. Williams and others, within the agglutinated false membranes, manifest indications of the inflammatory process,—redness, softening, recent effusion of lymph or semi-purulent fluid in small quantities in their interstices, or in the adjoining cellular membrane of the mediastinum: the physical signs of effusion, such as dulness on percussion, the rubbing sound and impaired impulse, are unfortunately wanting in these cases; they may occasionally perhaps be suspected from the existence of local pain or tenderness on pressure, or the unusual excitement or irregularity of the heart's action.

When pericarditis assumes the chronic form the prospect of recovery is much fainter; it may run on for two or three months with various alternations of improvement and aggravation, and then pass into a slow state of convalescence, or, what is but too frequently the case, may on the other hand, terminate in death, which occasionally takes place suddenly and unexpectedly, though more commonly, gradually, through the mere exhaustion attendant upon continued irritation.

When the disease has lasted out some months the morbid contents of the pericardium consist most commonly either in a transparent serum, or in very thick and firm false membranes made up of many layers indicative of successive aggravations of inflammation; and in the midst of them are occasionally circumscribed purulent or tubercular deposites.

In children, with all the physical signs and symptoms of profuse pericardial effusion, we have known very remarkable recoveries to ensue, and this, on one occasion, almost solely by the unaided powers of nature.

Diagnosis. Where pericarditis exists in its simple state its diagnosis has been pronounced by Louis to be no more difficult or obscure than that of pleurisy. In at least a half of all the cases analyzed by him there was during life sufficient evidence of its presence, from the union of a greater or less number of the following symptoms,—pain, or tenderness on pressure, oppression of breathing, palpitations, inequality or intermittence of the pulse, unnatural prominence, and dulness of sound over a greater extent than natural of the præcordial region, and confined to

it, to which subsequent observers have added the frictional and creaking sounds already alluded to; and all these have an additional value and clearer signification, when occurring in a patient previously healthy. Most of these signs and symptoms, it is true, are met with also in water in the chest, and some of them in aneurism of the aorta; but the greater rapidity of the inflammatory affection, even if pain be absent, will generally sufficiently distinguish it.

In the course of cases of acute rheumatism of the extremities, we should ever be on the look-out for inflammation of the surfaces of the heart, and be ready to act upon the first indications of its existence, such as the sudden supervention of cardiac pain or oppression, extreme anxiety and restlessness, with notable change in the pulse and respiration; but, above all, the characteristic auscultatory phenomena, which should be sought after frequently and at very short intervals, inasmuch as they are by far the most constant signs, and often precede, by some time, the other evidences of its existence.

In pleurisy and pneumonia we should likewise be prepared for the extension of the inflammation to the heart, or its original, though it may be obscure, co-existence there. Even in the course of continued fevers, the sudden supervention of irregularity of the pulse, especially if accompanied with unusual anxiety, should direct our attention forthwith to the heart, and the possibility of its having become the seat of inflammatory action.

Bouillaud asserts, that dulness of sound, and prominence in the præcordial region, occurring along with the stethoscopic signs (rubbing and creaking sounds,) and sudden fever in an individual who had previously no symptoms of organic disease of the heart, afford certain evidence of pericarditis, even though there be neither irregularity of pulse, dyspnœa, oppression, nor pain; and Dr. Hope is persuaded that even with a still smaller number of signs, namely, increased action of the heart, fever, and a murmur which did not previously exist, we may detect inflammation of this organ; and that by the nature and situation of the murmur, we may generally still farther decide whether the affection be pericarditis, endocarditis, or both. Dulness on percussion, though a valuable sign, is fortunately not indispensable, being often absent, as is still more frequently præcordial prominence. When endocarditis co-exists, as the researches of Watson, Hope, Bouillaud, and others have proved it to do in the vast majority of cases,—if it be so situated as to cause regurgitation through the aortic orifice, the pulse will be jerking, or even attended with a thrill in some cases; and we shall hear a valvular murmur coincident with the second sound of the heart. If the murmur be simultaneous with the first sound, on the other hand, impediment either in the auricular or aortic openings may be inferred. The valvular murmurs (which in themselves afford, as Dr. H. farther remarks, strong presumptive evidence of pericarditis, seeing how frequently it complicates inflammation of the inner membrane,) may almost always be satisfactorily distinguished from attrition murmurs by applying the stethoscope a couple of inches or more upon the aorta or pulmonary artery where murmurs connected with the semi-lunar valves will be very distinct, whilst those originating in pericardial friction will, for the most part, be inaudible; and also by searching for murmurs of the auricular valves a little above the apex of the heart, which will always be found to be their point of greatest intensity; whereas this, in respect to external murmurs, is altogether indetermined. The attrition murmur almost invariably accompanies both sounds of the heart. In one or two instances only, Dr. H. has known it to be confined to the first sound; and in a few others, it has assumed the character of a continuous rumble, owing apparently to the churning of a small quantity of fluid, in addition to the pericardial roughness. It is ordinarily of a rough or rustling character, and more frequently accompanied by the purring tremor than are the valvular murmurs; and varies its situation and intensity with the precise seat and progress of the inflammation. Dr. Watson has recorded a case where it was unusually loud and audible over a great part of the chest; but this is very rare.

It is where the inflammatory symptoms and effusion are very slight, or where

pleurisy of the left side co-exists, that the recognition of pericarditis is peculiarly difficult. A simple pleurisy of the left side might be mistaken for pericarditis, but only by a very careless observer.

The early symptomatic derangement of the cerebral functions, evinced by the coming on of delirium, stupor, &c., throws considerable difficulties in the way of the diagnosis, both by taking the attention off from the true seat of the disease, and by depriving us of a knowledge of such peculiar signs of the disease, (as pain, tenderness, anxiety, sense of palpitation, &c.,) as can only be ascertained through the rational consciousness of the patient; and such cases have actually been repeatedly mistaken by practitioners of the first eminence for idiopathic inflammation of the brain. Yet even here, if we have any suspicion of the true nature of the case, a recurrence to physical evidence will often clear away all obscurity.

Pleurisy and pneumonia are to be distinguished from pericarditis by their appropriate signs and symptoms detailed in another part of this work. When after an accurate investigation, we are satisfied that neither of these affections exists, this negative fact may be of great value towards the establishment of the presence of cardiac inflammation, where its local symptoms are obscure.

The sound of friction, sometimes heard in pleurisy, may usually be distinguished from that in pericarditis, by its ceasing on holding the breath. Yet it is just possible that the impulse of the heart against the lungs may at times give sufficient motion to the inflamed and coated pleuræ to produce this phenomenon; and when the diaphragmatic portion of the left pleura is its seat the diagnosis is peculiarly difficult.

An enlarged and feebly acting heart may be distinguished from the case of a profuse pericardial effusion with weak impulse and distant indistinct sounds, by applying the stethoscope to the supra-clavicular region, where in the latter case, and in it only, the cardiac sounds will be heard with considerable clearness in the course of the carotid and sub-clavian arteries, indicating that their feebleness in the præcordial region is the result of an obscured, rather than of an actually deficient action.

When the disease is accompanied with vomiting hiccup, and epigastric pain and tenderness to the touch, great general debility, with sinking and irregularity of the pulse, and cold sweats, it may readily be mistaken, if attention be not directed to the physical signs, for acute gastritis in its fatal stage.

Pericarditis in the chronic stage, accompanied with profuse effusion has been known to push down the liver so far below the right hypochondria, as to give rise to the erroneous supposition of disease and enlargement of the latter organ. Such a case is mentioned by Mr. Adams in the Dublin Hospital Reports. In respect to diagnosis, the same author lays much stress on the distinction between the transient rheumatic affection of the heart, such as other muscular and fibrous organs are liable to, and the more serious inflammation of its serous membrane, occurring in connexion with acute rheumatism—a subject which has recently been much enlarged upon by M. Chomel.

The great variability and frequent inconsistency of the symptoms have been considered peculiarly characteristic of pericarditis, as likewise the intense restlessness, the anxious, frightened look, the early supervention of weakness and irregularity of pulse, before the general strength is proportionably reduced—the intermitting nature of this derangement, and the frequent want of correspondence between the state of the pulse and that of the skin.

Causes. In some instances it is found impossible to ascertain the *exciting* cause of this disease; certainly, however, not so frequently as Louis is disposed to think. In far the greater number it is distinctly attributable to the influence of cold, or of cold and moisture, acting on the body when over-heated and fatigued, as is obvious from its ordinary connexion with rheumatic inflammation, and its frequent coincidence with pleuro-pneumonia,—as well as from the circumstance of its occurring more particularly during severe and changeable weather, and es-

pecially in spring. The frequency of its rheumatic origin has been recently insisted on, much and justly, by M. Bouillaud in France. This part of its history has, however, long been familiarly known to medical men in our own country. The connexion of disease of the heart with rheumatism was first noticed by Dr. Pitcairn fully half a century ago, and was soon after made more generally known to the profession by Dr. Baillie. Sir David Dundas and Dr. Wells subsequently recalled attention to it, and the latter seems with his usual penetration to have taken a just view of its inflammatory nature. Mr. Adams, in the excellent practical paper on diseases of the heart already alluded to, has dwelt particularly on the relation of pericarditis to rheumatism—yet by the French school, till very lately, all this appears to have been overlooked. Corvisart had but an obscure, or at least a very inadequate idea of the importance of the latter affection in the production of diseases of the heart; and even Louis, though so recent a writer, scarcely notices their connexion.

Bouillaud believes that at least one-half of all the cases of acute rheumatism occurring in practice, or what is ordinarily called rheumatic fever, are accompanied in some part of their course by an inflammation, either of the internal or of the external lining of the heart, or both, which tends greatly to the prolongation of the illness; and that these latter affections have, in fact, in very few instances any other source. He does not, however, admit that they are so often, as is commonly supposed, the result of metastasis, but asserts that they originate in very many cases simultaneously, and proceed *pari passu* with the articular affection. We are inclined to believe, however, notwithstanding his high authority, that the instances in which the ordinarily received opinion holds good are numerous. The sero-fibrous structure of the pericardium, and of certain portions of the interior of the heart, is precisely such as should lead us to expect intimate sympathy with the inflamed synovial and ligamentous tissues of the joints. Sometimes, though rarely, the inflammation persists in an intense form, both in the heart and joints. More commonly, however, in proportion as it becomes more violent in the one situation, it is mitigated in the other.*

Cases of traumatic as well as of spontaneous erysipelas, in which the metastasis of inflammation to the heart occurred, are alluded to by Mr. Adams. They proved fatal within 48 hours; orthopnea, great anxiety of countenance, and other symptoms of pericarditis, having supervened immediately on the disappearance of the cutaneous redness.

Though no age is exempt, yet children, and individuals about the period of puberty, are peculiarly liable to the translation of rheumatism to the pericardium; and especially in those cases where the synovial membrane is the seat of the inflammation, for, where the muscles are alone affected, metastasis is, according to the author last named, a much rarer event.

Persons of a full habit and sanguineous temperament, and in the flower of life, seem most disposed to attacks of pericarditis. The gouty and the rheumatic are peculiarly prone to it, no less than to many other forms of cardiac affection.

Convalescence from fever is frequently arrested by its supervention. It may be directly induced by external injuries, blows, falls, and penetrating wounds, and may originate also in the extension of inflammation from a neighbouring organ, more especially from the lungs and pleuræ. Continued over-exertion of body and great anxiety of mind, the suppression of habitual discharges and eruptions, the inflammatory tendencies connected with measles, small pox, and more especially scarlet fever in its convalescent period, may also be enumerated amongst its occasional causes.

Of its *predisposing* causes little can be said with certainty. According to M. Louis the male sex is more liable to it than the female, in the proportion of three

* Dr. Bouillaud is in the right. It occurs much more frequently during the height of the rheumatism, and only occasionally from metastasis. G.

to one. The period of life between the tenth and thirtieth years appears to M. Bouillaud the most prone to it. M. Louis has noted most cases of it between the twentieth and thirtieth years, and between the sixtieth and seventieth—the periods at which, respectively, the tendency to inflammation and to ossification and other organic changes, is most conspicuous. But the results of both these distinguished pathologists have, it must be remembered, been attained from the experience of adult-hospitals, almost exclusively. In earlier childhood it is by no means infrequent, and extreme infancy itself is not altogether exempt from it.

In respect to its very common connexion with organic disease of the heart, and especially enlargement of the organ, it exists sometimes as a cause, and sometimes as a consequence. Abuse of fermented liquors is enumerated by Dr. Elliotson amongst the sources of the insidious chronic form of pericarditis as well as of disease of the valves and orifices.

Pericarditis appears sometimes to have reigned epidemically: twenty cases once presented themselves to a single practitioner, within ten weeks, in a moderate-sized town in France. Not long since the journals contained an account of an hæmorrhagic pericarditis in Russia, of an epidemic and scorbutic character. Dr. Elliotson remarks, that the cases in which he had usually found a bloody fluid within the pericardium are those where the heart was softened.

Treatment. In the acute stage, when early seen, we should proceed instantly to the most vigorous employment of antiphlogistic remedies. Blood should be immediately taken from the arm in considerable quantity, and in a full stream; and as soon as the immediate effects of the operation have passed away, leeches in large number (twenty to forty in strong adults) are to be applied, or cupping practised over the præcordial region. If the violence of the symptoms persist, each of these measures must be repeated as freely, and at as short intervals as the age and strength of the patient permit, and as the intensity of the inflammation demands. Not a moment should be lost in thus reducing the quantity of the circulating fluid, and diminishing at once the natural stimulus of the organ, and, as far as possible, the quantity of labour to be done by it, and at the same time, moderating the excited action of its capillaries; for, as we have seen, if effusion in large quantity, either of coagulable lymph, or of a more fluid character—and especially the latter—has once been permitted to take place, the chances of ultimate and perfect recovery are very much impaired; and the power of the patient to bear active treatment after such an occurrence is no longer the same.

In the earliest stage of this as of many other inflammations the tartrate of antimony in large doses, as exhibited by Laennec in pleurisy, is often a valuable auxiliary to blood-letting; it is however far inferior in efficacy to the remedy next to be mentioned, and when not speedily very decisive in its effects should be at once relinquished.

If we find that in spite of the above measures, carried as far as prudence will permit, the inflammation continues to make progress, and especially if the effusion of fluid is actually commencing, no time should be lost in having recourse to the invaluable compound of calomel and opium (for the general use of which in such cases in this country the profession is indebted to Dr. Hamilton of Lynn Regis,) which exercises so remarkable an influence over inflammation in serous and other analogous membranes, both checking the morbid action, and promoting the absorption of such morbid products as it may already have given rise to. Doses of from three to five grains, or upwards, of the former, guarded by from a quarter to half a grain of the latter, or an equivalent portion of Dover's powder, to prevent it running off by the bowels, should be given every fourth hour till its specific effects is manifested on the mouth, or till the disease begins to yield; and even then the mercurial is not to be suddenly relinquished, but on the contrary very gradually withdrawn, as well on account of the frequent tendency of the inflammation to recur, as lest any portion of the effused matter might still remain unabsorbed, and become the germ of ulterior disease.

Absolute repose of mind and body, and total abstinence from food, are also very important elements in the early management of these cases.

In placing blood-letting and the exhibition of mercurials so prominently forward, we are influenced by the conviction of their constituting incomparably the most essential and efficient part of the treatment. Where there is difficulty in bringing the system under the influence of mercury, in addition to its internal exhibition mercurial ointment should be introduced into the axillæ, and left there to be gradually absorbed; and at the same time fumigations with the Hydrargyr. c. Cretà or with the mercurial candle may be practised. Amongst the auxiliary remedies are to be enumerated the promotion of moderate evacuations from the bowels, especially at the commencement of the disease, by some mild aperient, avoiding at the same time the dangerous and absurd error of trusting, like certain empirics of our day, the cure of the inflammation of so vital an organ to purgatives chiefly or alone.

When tartrate of antimony in the larger doses, alluded to above, has appeared inapplicable to the case, fractional doses of it, or of James's powder or ipecacuanha, to relax the skin and modify the inflammatory action, should be employed.

Diluent drinks in moderate quantities, to reduce the stimulant quality of the blood, without over-distending the vessels, with the addition of the nitrate of potass in as large portions as can be borne by the stomach and bowels, (as, for instance, one or two scruples to the pint,) are useful adjuvants in this and other analogous inflammations especially if of rheumatic origin.

After the first vehemence of the disorder is past, and effusion has already taken place, but not on any account previously, large blisters must be applied over the seat of the inflammation, and dressed with mercurial ointment to aid in bringing the system under the desired influence of this remedy; and at the same period the employment of sedatives, as camphor, hyoscyamus, or digitalis, prussic acid, or one of the salts of morphia, may be had recourse to when the excited state of the heart, and the anxiety and restlessness continue extreme, and seem to depend rather on a high degree of nervous irritability surviving the inflammatory action than on this latter itself.

Enveloping the chest in large emollient poultices is considered in France and Italy a measure of some efficacy; and, inasmuch as it determines locally to the skin and tends to moderate deep-seated pain, it is a point of treatment not unworthy of imitation, where no inconvenience arises from the weight of the application.

The importance of absolute repose is obvious from the fact that every the least movement, or the slightest effort, as in speaking or coughing, reproduces the irregularity of pulse, and aggravates the other symptoms.

With regard to blood-letting, it is right to state that though all practitioners are agreed as to its importance, some difference of opinion prevails as to the most effectual and safe method of employing it, and as to the extent of benefit to be expected from it. Thus M. Bouillaud, who is a great advocate for large and rapid reiterated venesections, declares that, of late years, since he adopted this method, he has scarcely ever failed to cut short any case of pericarditis to which he was early called. He commonly takes blood three or four times from the arm, to the amount of about a pound or better each time, within the first three or four days, and employs leeches and cupping at the same time as frequently. Dr. Hope's method of employing blood-letting is very similar: blood is drawn freely from the vein by a large incision, so as to bring the patient to the verge of syncope; and this, as well as the local bleeding, is repeated twice, thrice, or oftener, at intervals of eight or twelve hours, till the pain is subdued, or as frequently as the state of the pulse, or rather the action of the heart, demands. He is, however, much less sanguine than the French practitioner just mentioned, as to its being adequate of itself in all cases, or even generally, to cut short the inflammation. "The antiphlogistic treatment, alone," says he, "is not to be relied on: rarely, if ever, does it in a severe case

effect a complete cure." The disease too often proceeds uncontrolled by it to a fatal termination: at other times it partially yields, but the heart's action long continues of unnatural strength; and in other cases, though it may appear to have regained its healthy action, yet palpitations and symptoms of organic affection manifest themselves as soon as the patient resumes his accustomed occupations: and hence, like Dr. Latham, Elliotson, and all the best British practitioners, he has recourse early to calomel or blue pill and opium in large doses, to which occasionally mercurial inunction is superadded, or it is altogether substituted if the internal use of the medicine disagree.

Dr. Williams, whose remarks on the treatment of diseases of the heart are in general in the highest degree judicious and practical, deprecates the employment of copious venesection in inflammations of this organ, unless perhaps in their very earliest period, as he apprehends that its effect where the central organ of the circulation is primarily implicated, must be, in the first instance, to transmute the inordinate into defective action, and so to augment the embarrassment of the circulation, and keep up the feelings of dyspnœa, faintness and agitation; and, in the second place, to lay the foundation of subsequent reaction—consequences which he supposes must more readily ensue in the case of the heart in a state of inflammation than in that of any other organ. "Whether this be the true view of the case or not," he continues, "I have been convinced, by repeated observations of different kinds of practice, that both pericarditis and endocarditis, and especially if connected with rheumatism, are most safely and effectually treated by *moderate* general blood-lettings, avoiding as much as possible sudden or full impressions on the circulation; and that local bleedings, free and repeated, should in all cases be employed, as a measure of at least equal importance."

We must not, however, let the irregularity of the pulse, nor its feebleness at the wrist, nor the apparent debility of the patient, prevent us from taking blood if the complaint be still of recent origin, and the pain and other characteristic local and general symptoms seem to demand it. Young practitioners should, on the other hand, be cautioned against being guided too much by the buffed and cupped appearance of the blood in this affection, for this, where the disease has a rheumatic origin more especially, will commonly persist in spite of the freest sanguineous evacuations, or will even augment under their use.

If unfortunately we should not be called to the case till after it has already existed for some days, and the debility of the patient is such as to render venesection hazardous, local depletion by leeches may often still be practised with great advantage. Dr. Elliotson thinks he has observed free local bleeding to be more serviceable in all cases than general, and that calomel and opium is a still more important agent than either in the subjugation of this as well as most other inflammations, and in conformity with the opinion we have already expressed, that it is far superior to the tartrate of antimony even in the large doses in which it is exhibited in Italy and France.

Colchium also is often of decided utility, especially when the disease is of rheumatic origin, and after its first violence has been reduced. It has sometimes also proved adequate to the cure of the chronic form on persevering many months in its exhibition. When the disease has passed into the chronic stage leeches should still be occasionally employed on the revival of the pain, or other evidence of the re-excitement of the inflammatory process, and blisters must be repeatedly applied; or, at a later period, more permanent forms of counter-irritation ought to be had recourse to, as frictions with tartar-emetic ointment or croton oil, an issue or seton, or the repeated application of the moxa, a remedy in which Baron Larrey has such unbounded confidence both in respect to controlling local inflammation and producing the absorption of morbid products. In the selection and continuance of these remedies, we must of course be guided as much by their effects on the general health as by the state of the local disease, as in a prolonged affection of this kind any application which produces great irritation in the system cannot but diminish the prospect of ultimate recovery.

Counter-irritation applied to the extremities may sometimes be substituted with advantage for that in the immediate proximity of the disease. Mild mercurial courses, where they do not induce too much constitutional derangement, will generally deserve repeated trial, with a view to causing the re-absorption of remaining morbid effusions, as well as to counteract the low disorganizing inflammatory process which so often survives the more active form of the disease; especially in those cases where inflammation of the interior lining, as so frequently occurs, complicates that of the exterior. The cautious exhibition of diuretics and purgatives is also frequently called for in the chronic stage. The diet should be gradually improved, but still restrained within the strictest bounds of moderation, the object being to maintain just such a degree of strength as is requisite to bear the patient through a tedious reparative process, and at the same time to avoid every thing which can accelerate the pulse or rekindle the local inflammation. Even in the most favourable cases the accustomed avocations and habits of living should not be returned to till after the lapse of a very considerable period. There is no point which should be more pressed on the mind of the patient than the absolute necessity of avoiding, for a length of time afterwards, every violent excitement of mind or body, and all excessive or prolonged muscular exertions.

When tumultuous action of the heart and other symptoms of incipient hypertrophy of the organ manifest themselves amongst the sequelæ of pericarditis, a favourite mode of treatment with M. Bouillaud is the introduction of digitalis by the endermic method, by daily sprinkling the skin, denuded of its cuticle by the previous application of a blister, with about ten grains of the substance in powder; whilst at the same time he cautions us against its use in those cases where, from the presence of a very abundant effusion of fluid or of thick masses of false membrane, there is reason to suspect a weak and atrophic state of the heart has been induced.

Turpentine, in doses sufficient to excite some degree of urinary irritation, from its known efficacy in promoting the absorption of effused lymph, of which we have ocular demonstration in the case of iritis, is likewise deserving of trial in the chronic form of disease, and especially in cases of rheumatic complication. The hydriodate of potass, in doses of from three to five grains and upwards, in solution thrice a-day, has sometimes been administered advantageously with the same view and in the same stage of the disorder; and this substance may also at the same time be externally applied. The introduction of the alkaline sub-carbonates into the patient's drinks has also been recommended as a means of promoting the action of the kidneys, favouring absorption, and modifying the composition of the blood; and is especially applicable to those cases where the urine exhibits an unnatural excess of acid, or where the blood coagulates too firmly, or other evidences of an inflammatory tendency exist. Where some degree of pain or uneasiness continues long after the primary attack, anodyne liniments or a plaster of belladonna, or an ointment containing a minute portion of veratria or aconitine, should be had recourse to as palliatives.

When in spite of the employment of the measures above indicated there is evidence of a considerable effusion persisting long after the original inflammatory attack, and when the motions of the heart appear in consequence of its pressure to be greatly deranged, the attempt to procure relief by means of a surgical operation, to be described hereafter in the article on hydrops pericardii, might possibly, in some very rare instances of chronic pericarditis, be justifiable.

Pericarditis is, as we have already seen, peculiarly apt to recur; but, fortunately, subsequent attacks are commonly very inferior in intensity to the original ones, and are much more easily controlled. Hence their treatment does not require to be by any means so energetic; nor, indeed, would the constitution be now able to sustain the same powerful antiphlogistic measures. A single moderate venesection, or local blood-letting alone, the cautious exhibition of mercury, and the employment of derivatives, are usually sufficient to check them, espe-

cially if the action of the bowels, kidneys, and skin be simultaneously promoted.

In children, even of a very tender age, pericarditis is, as already stated, by no means a remarkably rare affection, occurring most commonly in complication with rheumatism of the joints, or with pleuritic or pulmonic inflammation, or as a sequela to the febrile eruptive disorders: its treatment in such cases is to be conducted on the principles already laid down: the early and active use of antiphlogistic remedies, blood-letting, general or local, or both; calomel, with James's powder; colchicum, purgatives, diuretics, and counter-irritants, with strict confinement to bed and a very low scale of diet, constituting the chief means for its reduction. These cases go on generally much more favourably, and are more rapidly amenable to treatment than examples of the same affection in adults, and even when the effusion has already existed for several weeks its complete absorption is by no means to be despaired of.

The remarks of the author as to the symptoms and treatment of pericarditis are strictly applicable to the most violent form of the disorder, in which the distress of the patient is often extreme, and the means of treatment should be of the most energetic kind. But it would be a great error to suppose that in the majority of cases of pericarditis the symptoms were violent, or that the disease tended in those cases towards a fatal termination. On the contrary, the disorder is strictly latent to most physicians, that is, to all who are not conversant with the pathology of heart affections, and the physical means of investigating them. And in not a few cases cannot be positively ascertained, notwithstanding the improvement in our means of investigation. Yet pathological anatomy shows us that an immense number of individuals have laboured under pericarditis and recovered; while the clinical examination of patients actually suffering from this disorder shows us that the general signs of it are most obscure, and that, although the physical signs are pathognomonic when they exist, they are absent or badly marked in many slight cases.

While the treatment of pericarditis cannot well be too energetic in severe cases, in the milder ones local bleeding and repeated small blisters are the best remedies. The remarks of the author as to the relative advantages of mercury and antimony in the treatment of both acute and chronic varieties of the disorder are perfectly well founded: in all serous inflammation mercury has a decided superiority not only over antimony but over all other remedies. Although treatment is imperatively necessary in violent cases of pericarditis, and highly useful in moderate ones, yet the greater number of cases will terminate naturally in recovery even without treatment. This may be inferred from the large number of latent cases of the disease: but if the inflammation be severe, even if recovery take place, the after consequences are injurious from the formation of adhesions, as already pointed out in the text: although most of the organic diseases of the heart which occur after pericarditis depend less upon the inflammation of the pericardium than on that of the lining membrane of the heart which so frequently complicates it.

G.

ENDOCARDITIS,

OR INFLAMMATION OF THE INTERNAL MEMBRANE OF THE HEART.

Anatomical characters—in the acute stage—in the chronic, including DISEASES OF THE VALVES AND ORIFICES.—Symptoms and physical signs of acute endocarditis—of chronic endocarditis, and disease of the valves and orifices.—Causes.—Complications.—Duration.—Prognosis.—Endocarditis of children.—Treatment.

FOR our present extended knowledge of the inflammation of the inner lining membrane of the heart we are chiefly indebted to M. Bouillaud, who has devoted to its consideration a large portion of his elaborate work. It had not, however, altogether escaped the notice of previous writers, as a reference to the pages of Jos. P. Frank, Hildenbrand and Kreysig, Burns and Baillie, sufficiently testifies. But it is to the distinguished French author just named that the merit is due of having set it prominently forward as an occurrence of great frequency, especially in connexion with rheumatism, and as one of the most influential elements in the production of organic disease of the heart. Since he first fixed attention on it in his edition of Bertin's work published in 1824, it has been successively investigated by several of our countrymen,—Latham, Elliotson, Watson, Hope, &c. That it should previously have attracted so little general attention is mainly attributable to the evanescent nature of several of the morbid appearances which characterize it; for though the endocardium is allied to the serous membranes, and, like other tissues of that class secretes, when inflamed, serum, lymph or pus, yet from the contact of the secreted matters with the blood, they are commonly washed away by the torrent of the circulation as soon as formed, and in the greater number of instances leave no trace behind, save the slightest redness or tumefaction of the affected membrane. In some instances, however, the effused lymph seems to be of a more adhesive nature, retains its connexion with the membrane on which it is formed, becomes organized, and the source of various changes of structure in the interior of the heart; especially when poured out, as is most usual, in the neighbourhood of the orifices and valves. But even independent of such ocular evidence as is obtained on dissection, we are now acquainted with certain auscultatory signs, which, taken along with the general symptoms, co-existing affections, and causes of the diseased condition, enable us to decide, even during life, with a high degree of probability, as to its presence. From the researches of M. Bouillaud it appears that inflammation of the interior of the heart is at least as common as pericarditis, and is followed by still more important results; and though its early stage may not be attended with such incontestable anatomical evidences as the latter, yet those of its more advanced period are altogether analogous, and quite as satisfactory.

In the venous system, in which the circulation is comparatively slow and feeble, examples of the organization of coagulable lymph are still more frequently observed; and the similarity of the lining membrane of the veins to that of the heart, as well as the frequent extension of inflammation from the former to the latter, should have prepared us, prior to all positive evidence, to admit the existence of idiopathic endocarditis as not improbable.

Anatomical characters. The morbid appearances characteristic of inflammation of the inner membrane of the heart are divisible into three classes: the first, or that connected with the earlier period of the affection, consisting in redness,

thickening, infiltration, and softening of the membrane, along with the secretion of coaguable lymph or pus; the second, in organization of the effused matter, præternatural adhesion of the valves or narrowing of the orifices; and the third, in its conversion into a cartilaginous or bony tissue, and the consequent formation of permanent obstructions.

1. The redness which marks the earlier stage exhibits various degrees of intensity, from a slight blush to a deep scarlet colour, and has, in some instances, a bluish or brownish tinge. It may be either partial or general, but is commonly most evident on that portion of the membrane which lines the valves and orifices, and not rarely is entirely confined to these situations. This redness does not, for the most part, appear to consist in any very obvious capillary injection, but chiefly rather in a dyeing of the lining membrane, which, in its softened state, is, as we should expect, more prone to imbibition. The colour is not, however, removeable by washing; but continued maceration will extract it. It has been doubted by Laennec and many others, whether such redness were not rather of cadaveric than of truly inflammatory origin; but the frequent co-existence of unquestionable inflammatory products induces us to suspect that skepticism has been pushed too far on this point, and to assent rather to M. Bouillaud's view of the matter; according to which this redness is, at least very frequently, the result of increased vascular action; and most probably so, when met with in bodies in which putrefaction has not yet commenced, and when the coagulability of the blood has not been remarkably impaired, as, for instance, by diseases of a putrescent or typhoid tendency, and when death has not been preceded by a very long protracted suffocative struggle.

It is not pretended that from the mere appearance of such redness we can at once safely decide on its inflammatory origin; but from the colour, taken along with a certain set of symptoms observed during life, and afterwards to be detailed, we may often arrive at such a conclusion with a high degree of probability; and this probability becomes converted into certainty, if there is found to co-exist either thickening or infiltration of the same portion of the membrane, or if purulent matter or coaguable lymph is detected, smeared over or adherent to its surface. The simultaneous presence of indubitable traces of inflammatory action in the great veins in the neighbourhood of the heart, occasionally affords an additional source of conviction as to the true nature of the appearances within this organ. It is chiefly where the case has lasted two or three weeks that the redness is found to be accompanied by a thickening of the membrane, which is commonly most obvious on the valves, inasmuch as they consist of a double layer of the serous tissue, and are most frequently the points first inflamed. In many instances they have an infiltrated spongy texture, and softening of the lining membrane is often met with in the same stage; it appears also less perfectly polished than natural, and is more easily separated from the subjacent cellular tissue. Incipient ulcerations on its surface may, moreover, be occasionally detected; and these throw light on the mode in which perforation of the parietes of the organ and of its valves, afterwards to be noticed, may often take place.

The presence of purulent matter and of coaguable lymph is less frequently ascertained, they being usually, as we might expect, carried away by the passing blood as soon as formed. These substances have sometimes, however, been detected in the centre of a clot, or entangled in the meshes of the columnæ carneæ. The coaguable lymph from its adhesive nature, the more frequently of the two retains its hold of the surface when it has been formed, and is occasionally found attached to the valves or their tendons in the form of minute granulations; and in other instances, in that of a pseudo-membranous expansion, lining a portion of the interior of the auricles and ventricles. Sometimes too, a fragment of clotted blood becomes firmly attached to the internal lining membrane, and is eventually organized.

Whether endocarditis, even in its most acute form, ever terminates in gangrene is dubious. M. Bouillaud inclines to the affirmative, in respect to those cases

where, on dissection in addition to the peculiar morbid colour, texture and odour, indicative of this change, we find the blood unnaturally liquid or grumous, and mixed up with air bubbles; and when during life, in addition to strongly marked typhoid symptoms, there has been inordinate rapidity and irregularity of the pulse. He has not, however, adduced any very conclusive cases in evidence of his opinion.

2. Inflammation of the inner lining membrane of the heart, like that of the interior of an artery or vein, is thought by Kreysig to bestow on the contained blood a peculiar tendency to coagulation: and it has been observed that fibrinous concretions of an unusually colourless, elastic and glutinous nature, are often found in cases of acute endocarditis, adhering to the walls of the organ or to the fleshy columns or their tendons, and extending along into the great vessels. These sometimes appear to be in a state of incipient organization, and fragments of them are not rarely attached with peculiar tenacity to the edges and base of the valves, where they constitute, in all probability, a frequent source of permanent organic disease, in the form of *vegetations* or *granulations*; though there is reason to think that these originate still more frequently in the effusion of coagulable lymph, as they are commonest in the left side of the heart, where inflammation is also most common, and where coagulation is rarest. Such appendages, which are also occasionally met with adhering to the surface of the cavities, and more especially the auricles, are divided by Laennec, in relation to their form, into the *globular* and the *warty*. The former are commonly of a softer texture, like to concrete albumen or fibrin which has as yet undergone little change, being of a dirty white or yellowish colour, with sometimes a slight tinge of red, and resemble closely those granulations often found on the surface of the pleuræ or peritonæum, when in a state of chronic inflammation. The latter are of a firmer, horny, or cartilaginous consistence, and in form not unlike venereal warts, and they adhere very strongly. Each species varies in size from that of a pin's head to a small pea; and in their number, arrangement, and form, present great differences, being sometimes isolated, and sometimes aggregated into small cauliflower excrescences; whilst individually, they are either rounded, flattened or elongated, and in respect to their surface either smooth and polished, or rough and irregular. They rarely exist, when of old date, unaccompanied by induration of the valves and orifices, and when they are numerous and voluminous often contribute materially to obstruct the passage of blood through the latter as well as to impair the efficiency of the former. It has been remarked by Dr. Watson, that the warty vegetations on the semi-lunar valves affect particularly a festoon-like arrangement, being deposited in two short crescentic lines, each of which runs from the corpus sesamoideum towards the extreme point of the base of the valve, being placed some way interior to its free edge,—a line which anatomical investigation shows to correspond with the outline of the fibrous matter prolonged to a certain distance into the valve from the tendinous ring at its insertion.

There is sometimes a considerable shortening of the tendons of the auriculo-ventricular valves, quite capable of preventing their closure; and yet, when existing alone, liable to be overlooked upon a hasty examination.

The *adhesion of a valve* to the adjacent wall of the heart is a less rare occurrence than we might have expected, from the almost unremitted motion of the part and the constant contact of the blood. The valve is often in this manner so firmly glued down as to be totally incapable of fulfilling its functions, and this necessarily gives rise to great derangement of the circulation. But much the most frequent species of valvular adhesion is that which takes place between the adjacent laminæ of the valve itself, especially when the caliber of the orifice to which it is affixed, has become contracted.

Organized false membranes sometimes line a portion of one or more of the cavities of the heart, or, more rarely, form partial septa across them. The most common form in which they are met with, is that of whitish patches of a few lines in breadth on the endocardium, altogether similar to those so often seen on the exterior of the organ, and are, like them, generally easily dissected off, leaving

the membrane beneath nearly in its natural state. Apparent thickening of the endocardium is, for the most part, due to the presence of intimately adherent layers of organized lymph.

The membrane itself does, however, occasionally undergo a slight degree of hypertrophy, becoming also unnaturally opaque, and deprived of its smoothness and polish. The sub-serous cellular tissue, and the fibrous structure strengthening the orifices and entering into the composition of the base of the valves, very frequently participate in the hypertrophous tendency; and this holds good especially in regard to the mitral valve.

3. At a more advanced or chronic period of this affection we find almost invariably cartilaginous or osseous induration of one or more of the valves or orifices, with irremediable contraction of the latter and serious impairment of the motion of the former. The false membrane, the original product of inflammation, thus passes in process of time through a succession of changes characterized by a gradual increase of hardness; first, assuming the form of condensed cellular membrane, and, subsequently, a cellulo-fibrous, cartilaginous, and osseous texture; the adjoining natural tissue either partaking in the morbid change, or being gradually supplanted by the new structures. The cartilaginous and calcareous deposits manifest a preference for the base and edges of the valves, and are of most various form and extent, sometimes occupying a mere point; at others, extending into flat patches or irregular protruding masses; and, in extreme cases, invading the entire substance of a valve and its tendons, or completely surrounding and greatly narrowing and obstructing an orifice. The calcareous matter in and around the fibrous zones is, in some rare cases, so profuse, as to extend deeply into the muscular substance of the heart or even to protrude on its outer surface, and thus to give rise to a loud frictional sound of a peculiarly harsh and grating character. Where the induration of the valves is very considerable, they become in a manner fixed, and quite incapable of fulfilling their office, being often, moreover, crumpled or shrivelled up, perforated, or even torn across, and hanging like a foreign substance into the cavity; but more commonly, as already stated, they become adherent by their adjacent edges; and this is most especially the case with the auriculo-ventricular valves, which may thus be seen to form an inflexible spout, as it were, projecting into the ventricle, like the rima glottidis or os tinæ in miniature; or else if flatter, an osseous partition, between the cavities, irregularly perforated in its centre, the aperture being so small in some instances as scarcely to admit the point of the little finger. Inspected from the side of the auricle, the orifice here presents a very contracted, wrinkled, or puckered appearance, and seems converted into a funnel-shaped passage. The aortic and pulmonary orifices, where their valves are similarly indurated and adherent, assume either a triangular form, or become narrowed into the shape of a button-hole, the consolidated valves constituting thus an imperfect septum across the vessel.

The valves of the left side afford very much more frequent examples of all the above changes than those of the right, which is only in conformity with the general fact, that parts of more energetic action are more prone to morbid derangement; in addition to which, the greater abundance of fibrous tissue in the latter, as Corvisart has remarked, naturally renders them more susceptible of cartilaginous and ossific degeneration. Bichât, however, was quite in error in supposing the right side of the heart entirely exempt from such changes. According to Dr. Hope's experience, as stated in the year 1832, they are found diseased in one case out of every four or five; or, according to Dr. Latham's, in so large a proportion as one out of every three instances of induration of the left valves; but the more recent researches of the former of these writers, as well as those of Dr. Clendinning, render it now almost certain that there is a much greater disproportion than this, and that, in at least nine-tenths of the cases of valvular disease, it is found on the left side alone; in somewhere about one-fiftieth on the right alone; and in nearly one-twentieth on both sides. The pulmonic valve is even less frequently affected than the tricuspid. The morbid alteration detected in the valves

of the right side is commonly only of a cartilaginous consistence. The tendency to contraction in the orifices of the heart, under the influence of chronic inflammation of their lining membrane, is but an additional example of what has been so often observed in respect to passages leading from various hollow organs within the body, as the urethra, for instance, the cervix of the bladder, the œsophagus, pylorus, rectum, &c. It is only in the incipient or inflammatory stage, or before such organic change has established itself, that we have any great power over these morbid processes. When they have produced the permanent effects alluded to, the walls of the hollow muscular organ, behind the narrowed passage, become ordinarily increased in thickness from the constant effort to overcome the unusual opposition to the discharge of its contents; and at the same time, from the frequent state of distention, one or more of the cavities is often much dilated. Of all the orifices the aortic seems to be the most frequently the seat of obstruction, and next to it the mitral orifice.

In persons who have died in consequence of a permanently obstructed state of the circulation through the heart, there are usually found large masses of coagula within its cavities; but these, as M. Bouillaud remarks, being soft, gelatinous, and generally tinged throughout with blood, are very unlike the firm, white, elastic, adhesive concretions of such frequent occurrence in the acute stage of endocarditis. That the cartilaginous and osseous degenerations above described, are, in the majority of cases, of inflammatory origin (though this view of their nature was strenuously opposed by Laennec,) has been shown to be in the highest degree probable by the researches and arguments of M. Bouillaud, who has adduced as strong proof of it, both from analogy, and from the history of the individual instances in which these appearances were met with, as the nature of the case seems to admit of. Thus chronic inflammation in other serous, sero-fibrous, and allied membranes is very commonly followed by cartilaginous or osseous deposits, as we see, for instance, in respect to the pericardium and pleuræ, the periosteum, synovial membranes and fibrous capsules of joints. The osseous deposition in question is by no means peculiar, as so often assumed, to advanced age; a great majority of the cases of it, recorded in *The Clinical Treatise on Diseases of the Heart*, being in patients under fifty; nearly a fourth between sixteen and thirty; one in a child of ten years, another of seven, and a third in an infant under ten months. The frequent co-existence of traces of an old pericarditis or pleurisy along with the appearances alluded to, is also certainly decidedly favourable to the inflammatory theory of their source. Besides, in a very great proportion of these cases, indubitable symptoms of inflammation within the heart have manifested themselves at some antecedent period. The *causes* in which the disease within the heart appears to have originated, as well as the influence of an antiphlogistic treatment over its progress, conspire still farther to establish the fact of its being very frequently of a truly inflammatory nature; and if, in some of these instances, such inflammation is latent, or accompanied by no very well marked symptoms, this is no less incontestably the case, and that not very rarely, in regard to certain similar affections of the pleuræ and pericardium, especially when of a very chronic type, and unaccompanied by any notable effusion of fluid. Still, however, it must be admitted, many examples of it present themselves, especially in the aged, where no such source can, with any probability, be traced, and which seem to be connected simply with the increased tendency to osseous deposit, so commonly observable in advanced life.

Symptoms. Inflammation of the interior lining of the heart commonly give rise to a general sense of uneasiness, with a peculiar feeling of oppression and præcordial anxiety, which if carried to its highest pitch, may be accompanied by a tendency to syncope. Pain properly so called, is, even in the acute stage of the disease, very rarely complained of; and when it does exist, seems rather to depend on accidental complications, such, more especially, as pleurisy or pericarditis, than on the condition of the interior of the heart itself.

In the severer forms of the affection there are generally well-marked feverish

symptoms, heat and dryness of the skin, thirst, restlessness, and accelerated circulation. The character of the pulse, however, often contrasts remarkably with that of the heart's action, being small and feeble, and intermitting, even at times when the latter is most violent—a disagreement which has been ascribed by some to partial obstruction of the orifices by spasmodic contraction of the adjacent muscular fibres, but by others, on much better grounds, to mechanical impediment from congestion of the valves, effusion of lymph, or the formation of coagula within the heart; and it is at such times especially that the most formidable of the symptoms commonly ascribed to pericarditis, present themselves—extreme anxiety, jactitation, and cold sweats, pallidness and shrinking of the features, with an indefinite expression of alarm—oppressive dyspnoea, faintness and downright syncope. Where the impediment of the circulation arrives at a great height, there is marked evidence of venous obstruction in the tumefaction and bluish colour of the lips and cheeks, and slight infiltration of hands and feet; and, apparently from the same cause, temporary convulsive seizures like epilepsy have sometimes also been observed. It is only, however, in cases where the disease exists in its intenser form, that we are to expect to meet with such well-marked general symptoms as those detailed above.* When it is very limited in extent, or when it assumes a sub-acute or chronic form, they are much more obscure; and were it not for the physical signs appropriate to each, the discrimination between it and pericarditis would too often be impracticable.

Physical signs. In simple endocarditis the action of the heart, as judged of by applying the hand to the chest, appears uncommonly violent, and is perceptible over an unusual surface, owing, it is supposed, to the inflammatory turgescence of the organ; and it is sometimes, moreover, accompanied by a vibratory thrill.

On percussion, during the acute stage, we occasionally discover a considerable augmentation of the extent of dulness in the præcordial region, the space in which it is now perceived being, according to Bouillaud, sometimes more than twice as great as in the natural condition. Such dulness of sound in uncomplicated cases is readily distinguished from that originating in pericardial effusion, by the beat of the heart appearing quite superficial, (a circumstance which can generally be appreciated both by the eye and by the hand,) instead of being, as in the latter case, remote and indistinct, and varying remarkably with change of posture, both as to the points and in the degree in which it is felt.

It is auscultation, however, which makes known to us the existence of one of the most constant and characteristic of the phenomena of endocarditis—the *bellows-murmur*—the intensity of which increases with the vehemence and rapidity of the heart's action, and is sometimes sufficient to mask one or both of the normal sounds. When the impulse of the heart is very sharp the metallic ringing sound, already described, is occasionally audible. The frequency of the heart's pulsations is very remarkable in this disease, occasionally amounting to one hundred and fifty within the minute, or upwards; and they are often, moreover, irregular or intermittent, and of unequal force, some of them being altogether imperceptible at the wrist.

When the intensity of the inflammation has declined, the organic changes left behind, provided the disease was not nipped in the bud, give rise to a new set of

* This affection may be anticipated, according to Dr. Hope, if a person be *suddenly* attacked, with three signs:—1. Fever; 2. Violent action of the heart; 3. A valvular murmur, which is known not to have existed previously, and is distinguishable from the attrition-murmur of pericarditis.

He believes farther, that, in some rare instances, irregularity and weakness of the pulse and orthopnoea exists *temporarily*, and in a *moderate degree*, from mere disturbance of the nervous system, before any mechanical obstruction has taken place; an opinion in which we entirely concur.—AUTHOR.

general and local symptoms. When the inflammation has assumed the *chronic form* (and in this it sometimes appears from the first,) the structural alterations resulting from it may be limited to simple thickening, or hypertrophy of the affected tissues, or else, as is the case in a great proportion of instances, it may give rise to their permanent induration and complete degeneracy. When *induration of the valves* and *narrowing of the orifices* have been thus produced, a permanent vibratory thrill with irregularity or intermittence, and inequality in the force of the pulsations, are very common phenomena. The contraction of the ventricles seems sometimes to be, as it were, spasmodically performed at two or three rapidly successive imperfect efforts. A greatly increased extent of dullness on percussion often co-exists, and indicates for the most part, the complication of hypertrophy or dilatation, or of both. Auscultation almost always reveals the permanent existence of some of the varieties of unnatural murmur, of which we have spoken so much at large in the introductory observations. M. Bouillaud, out of upwards of one hundred cases of this disease, examined by him, asserts that he never failed to detect the *bellows-murmur* in some of its grades, or the *rasping*, *sawing*, or *musical* sound, accompanying one or both of the normal sounds of the heart, save in one solitary instance, and that one was imperfectly examined. Pain is an occasional, but not a necessary nor even an ordinary, accompaniment of the organic changes under consideration: a sense of weight and obstruction, or an indefinable uneasiness in the region of the heart is sometimes complained of. Palpitations, characterized by a great increase of the force as well as frequency of the heart's action, along with a tendency to faintness and syncope, are very common, especially on any unusual muscular exertion, as in the act of ascending a stair or walking up a hill; and also on the occurrence of any strong mental emotion; and under these circumstances, likewise, the morbid sounds, no less than the impulse of the heart, become much more intense. In fine, when there has existed for some years, or even months, a permanent murmur accompanying the action of the heart, with or without a vibratory thrill in the pulse and præcordial region, together with frequent irregularity in the circulation, confirmed disease of the valves or orifices may be very strongly suspected; and this suspicion, according to Bouillaud, becomes changed into absolute certainty when the following general symptoms at the same time manifest themselves: namely, great contrast between the pulse at the wrist and the action of the heart; the former being very small, though commonly hard and vibrating, whilst the latter is inordinately strong; evidence of serious impediment to the course of the blood, manifested in the obstructed state of the venous circulation,—as, for example, swelling and lividity of the features, congestion of the brain, lungs, and abdominal organs, passive hæmorrhage, and serous effusions into the cellular membrane of the extremities, and into the great splanchnic cavities, and, finally, dilatation of the jugular and other large veins in the vicinity of the heart. The phenomenon of a venous pulse, synchronous with the systole of the heart, and dependent on reflux from the right ventricle, is not unfrequently observed. When the auriculo-ventricular orifice is incapable of complete closure, either from its disproportionate dilatation, or from the shrivelling, or immobility in consequence of ossification or adhesion, of one or more of the laminae of the tricuspid valves, the derangement of the respiratory organs, at first noticed as only a slight shortness of breath on exercise, gradually increases in intensity till, under the title of asthma, or in the form of orthopnoea, it constitutes a most prominent and distressing part of the patient's sufferings. In such a state of things, the circulation within the brain becomes eventually deeply disordered, and the sufferer, after a long-continued mortal struggle, characterized by intense anxiety, jactitation, and incessant gasping for breath, at last falls for the most part into a sub-apoplectic condition, which speedily terminates his sufferings and his life. Valvular disease becomes almost always, sooner or later, complicated with morbid alterations in the cavities of the heart, in respect to size and strength; and the *general symptoms* of the two

sets of affections are eventually interwoven together. For their farther consideration, we must refer to the sections on hypertrophy and dilatation.

It is obviously much more easy to satisfy ourselves of the existence of mechanical obstruction within the heart than to determine with certainty the particular orifice in which it is seated. The difficulty to be encountered arises chiefly from the great similarity of the abnormal sounds in the several orifices when similarly diseased; from the close approximation of these apertures; and from the liability of each, when in a certain stage of morbid change, to produce a murmur under the influence of a reflux as well as of the onward current. Dr. Hope indeed believed that he had, several years ago, succeeded in discovering a series of diagnostic marks by which this difficulty might be overcome; and that, too, in the great majority of cases by the stethoscopic signs and pulse alone; though, at the time, he by no means neglected the confirmatory aid of the general symptoms. Thus, disease of the *aortic valves* appeared to him to be characterized by the præternatural murmur being loudest at the middle of the sternum, and by its being of a superficial and whizzing character; accompanying the first sound of the heart, if it depended on the onward current, or the second sound, if it originated in regurgitation; in which latter case it was much feebler. Disease of the *mitral valve*, again, by the murmur being of a more hollow or distant character, and loudest opposite to the left margin of the sternum, between the third and fourth ribs; its coincidence or alternation with the pulse determining, as in the former instance, whether it depended on the direct or on the retrograde motion of the blood. Either set of valvular murmurs might be attended with the purring tremor: it is commonest with mitral regurgitation; but it is only where it originates in the aortic orifice that it will be communicated, in the form of a thrill, to the pulse. Regurgitation was shown to be most frequent in respect to the mitral valve; being accompanied, when so situated, by a peculiarly weak and irregular pulse. Where disease existed simultaneously in both orifices, the circumstance would make itself known by the presence of each set of signs. Disease of the *pulmonic valves* is excessively rare, being seldom met with, except in cases of open foramen ovale. The apparent situation of the bellows-murmur accompanying it would be the same as in affection of the aortic valves, whilst its closeness to the ear would be still more remarkable. Induration of the *tricuspid valve*, which is likewise very uncommon, was said to be also recognisable by the site of its attending murmur; namely, about the middle of the sternum, and a little to the right of the mesial line. These signs, he asserted, had never, for several years deceived him as to whether there was or was not valvular obstruction; and “they have seldom failed to indicate, with perhaps more than necessary precision, the situation and nature of the affection,”—provided he had first satisfied himself that the morbid sounds were not the result of nervous or hysterical excitement, anæmia, or loss of blood, cases in which they are transient and intermittent; nor of pericarditis, all other signs of such affection being absent; nor, finally, of hypertrophy, the murmur persisting in spite of repose, venesection, abstinence, and other methods of calming the heart’s action. Such are the opinions expressed by Dr. Hope, in the first edition of his valuable work on diseases of the heart. Of the correctness and importance of nearly all the signs here given there can be no doubt; but it is certain that, in the hands of others, they alone were found insufficient in many cases for satisfactorily establishing the differential diagnosis of valvular disease;* and it appears to us not at all surprising that the attempt to make such distinctions, chiefly by reference to the situation of the greatest intensity of the morbid sound,—as if this corresponded immediately to the seat of lesion,—should prove abortive, especially when we consider that the most adjacent points of some of the orifices are, as we have already seen, only a very few lines apart, and that an ordinary stetho-

* This difficulty was participated in even by the most expert stethoscopists. Thus we find Dr. Graves and Dr. Stokes, so lately as September, 1838, expressing their conviction “that the

scope may be so applied as to cover at once a portion of the whole four apertures.

A nearer approach to a successful method of establishing the diagnosis in question has been made by Dr. Williams, who is guided in a great degree by the direction in which the current, or column of the blood, (or the tense walls of the vessels?) spreads the sounds, and the different manner in which they are transmitted to the walls of the chest.* Thus, murmurs generated at the origin of the great arteries are transmitted chiefly in the direction of these tubes; whilst those produced in the auriculo-ventricular orifices are conducted at once both by the current into the ventricles, and by the chordæ tendineæ and fleshy columns to the apex of the heart, and thence to the correspondent portion of the parietes of the chest. Accordingly, in *obstructive* disease of the *aortic* orifice, the accompanying murmur, ordinarily of a sawing or grating character, and coincident with the systole, is not only audible in that part of the chest with which the heart comes into closest contact (its apex in all cases, and its body or base also, where there is great hypertrophy,) but is likewise most distinctly heard along the upper half of the sternum in the direction of the innominata, and in that of the carotids, particularly the right one. The pulse is neither weak nor irregular, unless the contraction exist in a very marked degree.

Regurgitant disease of the same orifice produces a murmur, commonly very loud, about the middle of the sternum, and which greatly obscures the second sound of the heart, especially when sought for at the top of the sternum, or in the carotids, situations in which it is in the natural condition very distinct; though it may still be sufficiently audible about the middle and left side of the sternum, where the action of the pulmonic valves is unimpaired. This murmur, in consequence of the smallness of the reflux current, is seldom so rough as the former: at times it is musical in its character, and sufficiently loud. The obstructive and the regurgitant lesions are often combined, and thus give rise to a double or to-and-fro sawing murmur. The regurgitation not unfrequently stimulates the ventricle to a second contraction, constituting a reduplication of the pulse. A very remarkable condition of the arterial circulation has been pointed out by Dr. Corrigan as characteristic of aortic reflux, in which the pulse becomes momentarily hard and full; yet, in consequence of the permanent patency of the orifice, instantaneously afterwards recedes from under the finger, and so has a jerking or thrilling character; whilst the pulsation of all the arteries is from the same cause strikingly visible, the motion in these tubes exhibiting a peculiar wriggling or vermicular appearance, especially in the aged, in whom, having lost their dilatability, they are only capable of tortuous elongation. The value of this sign is admitted by Dr. Williams and Dr. Hope, who consider it to be almost pathognomonic of the lesion in question, when strongly marked and permanent in all conditions of the circulation.† In a slight extent it may, however, exist independent of such structural change, in consequence merely of simple excitement of the heart, especially where there is defective tension of the arterial system, as after large losses of blood, but here the pulse is invariably rapid. A new sign of inadequacy of the valves of the aorta, lately made known by Dr. Henderson, is the existence of a greatly increased interval between

physical signs of valvular disease are not yet fully established; that, taken alone, they are in no case sufficient for diagnosis; that, even in organic diseases, the nature and situation of murmurs may vary in the course of a few days; that all varieties of valvular murmurs may occur without organic disease; and, lastly, that organic disease of the valves may exist to a very great degree without any murmur whatsoever." (See *Dublin Medical Journal*.)—AUTHOR.

* In the third edition of his work on diseases of the chest published in 1835, and more fully in his lectures, delivered in the winter of 1836, and published in the *London Medical Gazette*, in the autumn of 1838.—AUTHOR.

† It may be neutralized, as Dr. Hope remarks, by free mitral regurgitation or great contraction, in consequence of the enfeebling effects of these lesions on the pulse.—AUTHOR.

the systole of the heart and the pulse in the remote arteries. The musical or cooing note, taking the place of the second cardiac sound, he farther asserts, is a circumstance which has hitherto only been found in cases of patency of these valves. Permanent patency of the aorta, if unaccompanied by obstruction, has, according to Dr. Hope, no systolic semi-lunar murmur, but only a regurgitant one.

Aortic valvular disease, though in its early stage it may only give rise to slight palpitation, shortness of breath on exercising, and præcordial uneasiness, is, when extensive, one of the most formidable of cardiac affections, and most speedily fatal. Hæmoptysis and dropsies are thought by Dr. Williams to be quite as frequent in connexion with it, as in disease of the mitral valves or of the right side of the heart. There is commonly, he believes, greater restlessness and irritability, and the features are more palid and puffy than in mitral disease, in which there is often a considerable degree of colour in the face, with greater hebetude and torpor; the symptoms in the latter being more simply those of venous congestion; but in all this there is, as he freely admits, much uncertainty.

The mitral valves appear to be much less frequently the seat of an obstructive than of a regurgitant murmur; which last, according to the author just quoted, in consequence of the facility with which the mechanism of the part is temporarily deranged by irregular action of the carneæ columnæ, &c., constitute a vast majority of the cases of bellows-sounds occurring in women and young persons under twenty years of age (in whom they are, besides, more generally of a blowing character than either grating or whistling;) whilst, in older persons, and those of the opposite sex, they are more frequently caused by the diseased state of the aortic valves. On account of the interposition of the lung and right ventricle, the murmur generated in the auriculo-ventricular orifice is much less distinct immediately opposite the mitral valve than over against the apex of the heart, where it is often so loud as to obscure the natural sound; this being still audible at the upper and lower ends, and to the right of the sternum, and over the carotids. Considerable enlargement of the heart, or consolidation of the lung, may sometimes transmit the murmur more distinctly to the walls higher up; but percussion, as Dr. Williams suggests, would sufficiently elucidate the nature of the case. The pulse is generally very irregular, unequal, and weak, when there is much constriction, or free regurgitation in the mitral orifice: in the latter case, however, it has sometimes been found strong and jerking, when dilated hypertrophy co-existed in a marked degree.*

The general symptoms produced by disease of the mitral valve are chiefly those of pulmonary and venous congestion, as evinced by the frequent asthmatic paroxysms and habitual dyspnœa, along with cough and an abundant expectoration occasionally tinged with blood, and by enlargement of the liver and disorder of its action, as well as of the other abdominal organs, too often mistaken, especially when the heart is as yet but slightly deranged, for idiopathic dyspepsia. There is, at the same time, a tendency to anasarca, and other dropsical affections, along with headaches, giddiness, and other evidence of cerebral congestion. It is from the occasional occurrence of such a group of symptoms in a very aggravated form, that the very name of *heart-disease* carries so much terror with it; but, in reality, affections of this organ often exist, in a minor degree, without any such formidable array.

Disease of the *pulmonary valves* is so rare that Dr. Williams, though he has directed his attention so much to cardiac affections, confesses himself unable to

* Of other causes by which irregularity and weakness of pulse may be produced, independent of valvular disease, Dr. Hope enumerates,—1st, Softening of the heart. Here there will be no morbid murmur. 2d, Pericarditis, with copious effusion compressing the heart; endocarditis; and polypi within its cavities. Their peculiar symptoms and suddenness of super-vention are diagnostic. 3d, Dyspepsia, biliousness, nervousness, gout, &c. Here the attacks are irregular, and temporary, and unattended with valvular murmur.—AUTHOR.

speak of its signs from his own experience, he having never diagnosticated an instance of it during life; but he conceives that the murmurs accompanying it might be distinguished from those of the aortic valves, by not being audible at the top of the sternum nor in the carotids, as also by the circumstance of the pulse being less peculiarly affected.

As to the *tricuspid* valve, he professes to be acquainted only with its regurgitant lesions, which are comparatively common, and recognisable chiefly by pulsation of the jugular veins; for the reflux here, in consequence of the natural laxity of these valves, and the inconsiderable degree of induration ordinarily present, even when diseased, is, he thinks, for the most part, unattended with any audible murmur. In a few instances, however, he has met with one of a blowing or grating character, coincident with the systolic sound, and distinctly heard from the middle to the bottom of the sternum, at the adjacent parts of the cartilages of the ribs and in the epigastrium, but not in the carotid or upper portion of the sternum.*

* Very similar views to those of Dr. Williams, detailed above, have more recently been advocated by Dr. Hope, in the *Med. Gazette*, August 4, 1838, and March 7, 1839; as well as in the new edition of his *Treatise on Diseases of the Heart*, which appeared last year. Thus the distinct audibility of the *semi-lunar* murmurs for about two inches above their origin is recognised by Dr. H. as their chief characteristic,—those of the *aortic* valves being more intense towards the second intercostal space, close to the right of the sternum; those of the *pulmonary* valves, at the same level, but towards the left of this bone; whilst auricular murmurs are scarcely to be heard at this distance; and those originating in diseases of the aorta itself, besides being more acute in their pitch, are considerably louder in the tract of the vessel than immediately opposite to the semi-lunar valves.

It is farther noticed, as confirmatory evidence of the existence of *semi-lunar* murmurs, that they become gradually less distinct as we descend along the tract of the ventricles; those originating in the aortic valves being, however, comparatively less faint along the course of the left ventricle; those of the pulmonic valves, along the right.

The murmur of *semi-lunar regurgitation*, though loudest in the site of its origin, and in some degree carried downwards by the setting in of the current in that direction, is sufficiently distinct upwards, in the line of the great vessels respectively, and is, moreover, prolonged through the interval of repose.

The murmurs of the *auricular valves*, it is farther stated, are best explored at about an inch above the apex of the heart, on the left side of the dull portion, i. e., about the fifth left rib, and a little within the nipple, for the *mitral* valve, and on the right side of the dull portion, at the same level, but close to the left edge of the sternum, for the *tricuspid*. At these points, the obstructive murmurs of the semi-lunar valves sound comparatively obscure and distant, whilst their regurgitant ones, unlike those we are now speaking of, augment in intensity as we ascend towards the orifices of the great arteries.

When both the semi-lunar and auricular valves are diseased, the morbid murmurs not only often differ in tone and character, but will have two distinct points of greatest intensity, up to which, respectively, we should endeavour carefully to trace them. When two murmurs have their source in the same orifice, we may recognise the fact by the circumstance of their existing in the greatest intensity at one and the same point; whilst the first coincides with the systole of the heart, the second with its diastole.

The comparative feebleness of a reflux current through the aortic and pulmonary orifices, as well as of the onward current through the auricular valves, accounts for the greater weakness of the correspondent murmurs. An obstructive mitral murmur is, of all those appertaining to the left side of the heart, one of the rarest, for the reason first mentioned; being seldom heard save in cases of very considerable narrowing of the orifice. Murmurs seated in the aortic and pulmonary orifices, from being more superficial, are in a higher key than the deeper-seated ones, connected with the mitral and tricuspid valves.

The greater or less harshness of the murmurs, and their pitch, vary with the force of the

Adhesion of the auriculo-ventricular valves to the wall of the heart is usually accompanied by their thickening and induration, and gives rise to symptoms very similar to those attending contraction of the orifices, from which therefore it is not readily distinguishable during life; viz. palpitation, bellows-murmur, purring, tremor, dyspnœa, venous congestion, and serous effusion; the reflux of blood being here equivalent to a mechanical obstruction. It is supposed by M. Bouillaud, however, that we may frequently be guided to a correct diagnosis by the bellows-sound being of a less dry and grating character in the case of simple adhesion, by the action of the heart being less irregular, by the purring tremor, if it exist, being less thrilling and more diffused, and the pulse less contracted, and, finally, by the dyspnœa, venous congestions, and serous effusions being less marked.

There are no symptoms yet known by which simple thickening of the lining membrane of the heart can be recognised; nor do the vegetations growing from it give rise to any signs by which their presence may be suspected, unless when they interfere with the action of the valves or with the caliber of the orifices; and even then they can scarcely ever be distinguished from contraction of these apertures, or from adhesion, with thickening of the valves. When they are of a very elongated form, and consequently very moveable, they may probably give rise to considerable variability in respect to the period and intensity of the murmurs, causing, in one position, an obstructive, and in another, (when inserted, it may be, between the edges of the valves,) a regurgitant murmur. This, together with a varying force in the current, a spasmodic state of one or more of the columnæ carnæe preventing the accurate closure of a valve, or, in some rare instances, the formation of fibrinous concretions within the cavities, are amongst the more probable causes of the occasional unsteadiness of the morbid sounds, even in the case of organic disease. The extreme disorganization of a valve, it should be known, often gives rise to a much less intense murmur than a change, which, though much slighter, may be better calculated for the production of sonorous vibrations: the former, even though there may be no great induration, generally causes a sound of a graver, deeper, and more grating quality; those produced by the latter being commonly in a higher key, and occasionally of a musical, whistling, or cooing character. (*Williams.*)

Of the diagnosis of murmurs which are independent of organic disease, and of those connected with pericardial inflammation, from those originating in valvular lesion, we have spoken at large in former sections.

Causes. Inflammation of the interior of the heart may come on either as a primitive or as a consecutive affection: its causes, in the first instance, are essentially the same as those of pericarditis and of acute rheumatism, in union with which it so often occurs; more especially cold and moisture, or exposure to very sudden atmospheric changes, especially when the body is over-heated or fatigued. Gout, intemperance, and long-continued and very fatiguing bodily exertions, hypertrophy, and nervous palpitations, predispose to it.

Complications. The disorders on which, when secondary, it most commonly ensues, are acute articular rheumatism, pericarditis, pleuro-pneumonia, and phlebitis. In respect to its connexion with the first of these diseases, however, which is so very frequent, it is the opinion of Bouillaud, that it occurs very often as a cutaneous no less than as a metastatic affection. The transmission of inflam-

circulation, the shape and size of the orifices, and the consistency of the matter forming their contour. Where they are of a very faint character, both auscultator and patient should hold their breath, and the deepest silence be preserved. A long stethoscope should be employed, so as to render it unnecessary to stoop much; a posture which, by causing congestion of the head, interferes much with the delicacy of hearing.—*AUTHOR.*

[A stethoscope, about two feet long, constructed of a coil of wire, the ends of block tin, the hollow cone for the reception of sound about three fourths of an inch in diameter, has been found the best for the discrimination of valvular murmurs.]

mation from the pericardium to the inner lining membrane, seems to take place more frequently than from the latter to the former. Endocarditis may be excited, moreover, by sudden and prolonged embarrassment of the pulmonary circulation, such as occurs in the violent spasmodic fits of coughing of aggravated whooping-cough; by the sudden rupture of a valve in a struggle; and also, like inflammation of the veins, by the absorption of putrescent matter, or the translation of purulent collections into the torrent of the circulation.

Prognosis. It may manifest itself either in an acute, a sub-acute or a chronic form. The prognosis to be formed in any given case of this affection depends not merely on the intensity and presumed extent of the inflammation within the heart, but also very materially on its complications, the age and strength of the patient, the period at which the treatment has been commenced, and the activity with which it has been pursued.

Duration. In its most acute form it may terminate fatally within a few days; death in such cases seems most commonly to be accelerated by the formation of extensive coagula (Polypi,) within its cavities. Striking irregularity, feebleness, and frequency of the pulse, partial cold sweats, with extreme anxiety and incessant disposition to syncope, are amongst the formidable symptoms preparing us for the final catastrophe. When the disease is met by energetic measures from the commencement, it may take a favourable turn within from three or four days to a week, even though attended by the formidable complications of pleurisy or pericarditis; and the patient, under judicious management, may speedily become convalescent. Should it pass unfortunately into the chronic form, its duration then is commonly little, comparatively, within the influence of medicine; and if the valves and orifices are very extensively implicated, it terminates sooner or later, almost necessarily, in death; hypertrophy and dilatation of the heart, sanguineous congestions and effusions of serum or of blood, being generally first induced, and serving to accelerate the fatal event, which sometimes takes place very suddenly and unexpectedly. When, however, the lesions which have taken place are of a slighter kind, and the morbid process which has given rise to them can be arrested, life may sometimes, notwithstanding their existence, be prolonged with care, even to a very advanced period.

Endocarditis of children. According to Dr. Copland, inflammation of the interior of the organ, even at a very early period of infancy, is by no means rare; presenting itself sometimes as a primary disorder; but more commonly coming on in consequence of scarlatina, small-pox or measles, pneumonia or whooping-cough, or, as in adults, in the course of acute rheumatism. When connected with the exanthemata, it is generally during the convalescence that it makes its appearance, commencing for the most part insidiously; but soon revealing itself to the careful observer, by the frequent, feeble, and irregular pulse; tumultuous action of the heart, and bellows-murmur; cough without pain or expectoration; dyspnoea on exertion, and subsequently orthopnoea; a sense of weight and oppression about the præcordium; an expression of anxiety and marked delicacy, together with feverishness in the evenings; and frequently, ere long, evidence of incipient hypertrophy and dilatation becomes quite obvious.

Treatment. It is to be treated altogether on the same principles as pericarditis; or, if any difference is to be made, it is only this, that the measures employed must be even more prompt and decided, in order to prevent the formation of coagulable lymph, or of polypus concretions within the heart, as well on account of the immediate danger attending their presence, as in regard to the ultimate risk of their becoming organized and the source of permanent obstruction. Abundant and repeated abstractions of blood, both general and local, together with the use of calomel and opium, constitute the most important part of the treatment in the most acute period. The exhibition of colchicum, or of digitalis, and the employment of counter-irritation in the shape of blisters, and in the various other forms already enumerated when speaking of the treatment of pericarditis, find a place at a somewhat more advanced stage. When it has unfortunately become chronic, either

through the neglect of treatment or its inefficiency, our chief resources consist in small venesections or leechings, and absolute rest during periods of aggravation of the symptoms; adherence to a low scale of diet; the occasional employment of digitalis; the cautious induction, from time to time, of a slight mercurial action, and steady perseverance in the use of counter-irritants where the general health is not materially deranged by their employment. Such appear to be the measures most likely to arrest the disorganizing process in the interior of the heart, to moderate the action of the organ, and retard the supervention of its enlargement. When organic lesions of the orifices and valves have, however, become once fully established, they admit at the most but of palliation. The support of the general health should here form a main object of attention; and the benefits arising from regulation of the digestive organs, the enjoyment of a pure atmosphere, and the gentlest exercise, studiously secured. Where dropsical symptoms have supervened, recourse must be had to the employment of diuretics and purgatives; a part of the management of these cases to which we shall have occasion to recur at a future page. Of the appropriate treatment of inflammation of the interior of the heart in children, it is unnecessary to speak particularly, it being altogether similar to that already laid down as suitable to the pericarditis of infancy.

Endocarditis is a very different disorder from the mere thickening of the valves or other portions of the lining membrane of the heart which so frequently follows it. The inflammation itself is an acute disorder, with the usual symptoms of inflammatory reaction in addition to those of the disturbance of the circulation caused by the derangement of the heart itself. In the lesions subsequent to inflammation the symptoms are limited to those of impeded circulation, and the physical signs furnish the best indication of their nature. In most cases those signs will point out the valve which is the seat of the lesion with very great precision, although there is still some uncertainty in a few cases.

Endocarditis, properly so called, may like other inflammations occur as primary or secondary. In the latter case it nearly always takes place during the course of pneumonia or of acute inflammatory rheumatism, when it is frequently connected with pericarditis. It then arises as a primary affection from the ordinary causes of inflammation, which act with more power and effect if the heart be previously enlarged. Whether the disease be primary or secondary there is always present one alteration, which sometimes exists in other inflammations, but to a less degree, that is, a highly fibrinous state of the blood with a strong tendency to the formation of coagula in the heart. This condition of the blood is more frequently a cause than an effect of endocarditis, and may be generated by any other inflammation, and thus react upon the lining membrane of the heart.

The symptoms of endocarditis are less marked than those of pericarditis with large effusion, but they are more decided than those of the slighter varieties of it. As soon as it occurs the action of the heart is more or less impeded, and the contraction of the ventricles is hurried and confused; hence a bellows murmur is developed in the first sound of the heart. This becomes a rasping sound if the valves be much thickened. The second sound is diminished and to a certain extent suppressed from the first, not from the thickening of the valves which occurs only at a later period, but from the congestion of the heart which necessarily attends endocarditis, and, as we have already seen, diminishes the second sound. Besides offering the bellows or rasping sounds the action of the heart is disturbed, so that it contracts spasmodically and without that sharpness of impulsion and regularity of time which is characteristic of the healthy heart: hence we may describe the action of the heart affected with endocarditis, as confused. It is not in most cases strictly irregular, although this sometimes happens, nor does it offer the strong heaving impulse of decided hypertrophy.

The general symptoms are very variable: pain, or at least a feeling of stricture and uneasiness across the chest is generally felt, with more or less febrile excitement, sometimes rising to high fever, with an active pulse; at other times the pulse is small, feeble, and scarcely developed. If the disease continue for a little time, or form slowly, the sub-cutaneous cellular tissue is often infiltrated, and acute dropsy may supervene. Still the general symptoms are not decided enough to furnish grounds for positive diagnosis.

The immense majority of cases of endocarditis terminate in more or less complete recovery; but frequently the inflammation is followed by various chronic alterations of the valves or muscular structure of the heart; hence a careful treatment becomes necessary, not only to diminish the actual mortality of the disease, but to prevent its after consequences. The rules for treatment, which are laid down in the text, require no important additions; when the disease is severe the depletory means must of course be proportionably active. G.

CARDITIS,

OR INFLAMMATION OF THE MUSCULAR SUBSTANCE OF THE HEART.

Infrequency of the disease.—Authenticated cases.—Anatomical characters.—Symptoms.—Causes and treatment.

CARDITIS, or Inflammation of the Substance of the Heart, comprehending its muscular tissue, and connecting cellular membrane, is a very rare affection, and its history as yet but imperfectly understood. Laennec has expressed his doubts as to whether there was on record a single well described case of indubitable inflammation of the whole heart:—he did not, however, deny its possibility much less that of partial inflammation of the organ characterized by abscess and ulceration, several authentic examples of which latter are to be met with in the works of various authors as well as in his own. But even of general inflammation of the heart unquestionable instances have presented themselves, and to very competent observers. Not to speak of Meckel's case, in the *Memoirs of the Berlin Academy* for the year 1756, a very remarkable one which fell under the notice of Mr. Stanley has been described in the *Medico-Chirurgical Transactions* for 1816, and has been more recently alluded to by Dr. Latham in his valuable lectures on Diseases of the Heart, he having also been present at the dissection. The subject of it—who, unfortunately, was not seen by either of these gentlemen during life, else the account of the symptoms would probably have been more satisfactory,—was a boy of twelve years of age, whose illness, obviously mistaken by the medical attendant for fever with predominating cerebral complication, terminated fatally on the fourth day. On the second day there had been pain in the left thigh and knee, doubtless of a rheumatic character, though apparently not recognised as such. Delirium supervened early, during which the only pain which could be detected on cross-questioning him was a slight one in the head. A convulsive fit occurred on the third day and on the fourth dyspnoea and sinking. He was capable of answering questions till within a few hours of his death. It is said that the action of the pulse and of the heart was unaffected throughout; but the case, it must be remembered, occurred at a period when the examination of the state of the circulation was generally conducted in a less complete, careful, and constant manner than at present. On opening the body the pericardium was found to contain four or five ounces of turbid serum with flakes floating through it. Coagulable lymph was effused on the interior of the pericardial sac, as likewise on the exterior of the heart, which was of its natural size. “Upon cutting through its parietes, the fibres were exceedingly dark-coloured, almost of a black appearance. This evidently depended on the nutrient vessels being loaded with venous blood. The fibres were also very soft and loose in their texture, being easily separable, and with facility compressed between the fingers. Upon looking closely to the cut surface exposed in the section of either ventricle, numerous collections of dark-coloured pus were visible in distinct situations among the

muscular fasciculi. Some of these depositions were situated deeply near to the cavity of the ventricle; while others were more superficial, and had elevated the reflected pericardium from the heart. The muscular fibres of the auricles were also softened in their texture, and loaded with blood, but without any collections of pus between them. All the cavities of the heart were loaded with coagulated blood." No traces of inflammation were discovered within the heart. Had this patient been carried off at a still earlier period of his disease it is probable that the heart would have been found nearly swollen, more vascular, or of an intenser red colour than natural. The appearances actually present prove at once the extent to which inflammation may affect the heart; and also, notwithstanding the doubts of Laennec, that softening of the muscular tissue is indubitably one of its occasional results; and it is one which we should have been prepared to expect from what has been observed in muscles elsewhere, as well as in various other organs, as the brain, lungs, liver, &c., when inflamed, friability or loss of cohesion being a very common prelude to suppuration. Another instance of carditis, of a somewhat more chronic type, was recently brought by Mr. Salter under the notice of the Medico-Chirurgical Society. It ran a course of seven weeks, and began, whilst the patient was walking, by an acute pain in the left side of the chest. This recurred again about a week afterwards, whilst using the same exercise, and became subsequently very frequent, and was now induced by the slightest exertion, as even by the effort of raising the arm. When Mr. Salter first saw him, about a week before his death, there was orthopnea, and an uneasy sensation or dull pain referred to the stomach and middle of the sternum. Notwithstanding the use of venesection, calomel, and opium, and counter-irritation, the disease proceeded unalleviated to its fatal termination. The pericardium was found inflamed, especially its diaphragmatic portion, with ecchymosed spots beneath its serous surface, and distention of its vessels. The substance of the heart was moderately firm; but the left ventricle had almost entirely lost the colour of muscle, and pus could be scraped from its surface, and in some parts there were small cavities in the muscular substance containing pus.

The heart, when in a state of softening, collapses on itself when emptied of its blood, and breaks down readily into a pulpy mass between the fingers. Its colour is various, being sometimes, as we have seen above, of a deep red, brownish or violet tinge, with occasionally a bloody fluid effused into the cellular membrane connecting the muscular fibres, or under the pericardium; or it may be of a pale or dirty white, which appears to indicate a more advanced or chronic state of inflammatory action, such as is occasionally observed in the superficial fibres of the heart in cases of chronic pericarditis with purulent effusion. It is not, however, denied that a very similar condition of the muscular substance may sometimes acknowledge other and very distinct sources. Laennec, who, as we have stated, was skeptical as to the inflammatory nature of the above-mentioned species of softening, has described another kind, characterized by its faint yellowish colour, which is very commonly confined to the deeper-seated muscular layers, and of which cachectic individuals are the chief subjects. With regard to the true nature of this variety, also, he is at issue with M. Bouillaud, who considers it, as well as the preceding, to originate in inflammation, but of a peculiarly chronic character. To Dr. Hope, who takes a middle and probably a more correct view, it has appeared to have sometimes an inflammatory, and sometimes a merely cachectic origin.

Ulcerations of the heart have their origin almost invariably in the internal lining membrane, though, in a few instances, perhaps, they have been produced by the bursting of a purulent collection formed within the walls of the organ, and making its way to one or other of its surfaces. They are of various depths—sometimes quite superficial, and at others penetrating so deeply as to lead to the complete perforation or sudden rupture of the organ, or else to lay the foundation of a consecutive false aneurism in its walls. The consequences of perforations will vary with their situation; if they take place through the external walls, instant death,

by the effusion of blood into the pericardium, is their natural and almost necessary result; whereas, if they pass through the septum, their only immediate effect is the mixture of the venous and arterial currents. If the ulceration is seated in a valve, or in one of its tendons or fleshy columns, the perforation of the first, or the detachment of either of the latter, gives rise to irregular and tumultuous action of the heart, and occasionally to a rapidly fatal train of symptoms of the most distressing nature—pain in the region of the heart, extreme anxiety, uncontrollable restlessness and impending suffocation.

Where a partial aneurism of the heart is determined in the manner above alluded to, its external surface most commonly contracts adhesions with the pericardial sac, which becomes by the irritation preternaturally thickened at the part, and this, together with the numerous layers of coagula within the tumour, tends materially to prevent its bursting, an event accordingly which rarely takes place in an early stage of the affection. Such aneurismal tumours have been met with of various sizes, from that of a nut to that of the heart itself, and often (at least of the smaller dimensions,) in individuals in which their existence had been quite unsuspected during life.

Amongst the occasional consequences of inflammation of the heart must also be enumerated *induration* of the whole or a portion of the organ. That this alteration is often of a truly inflammatory nature appears in the highest degree probable, from its frequent connexions with other affections of a similar origin, as endocarditis and pericarditis. Corvisart and Laennec speak of hearts in which the muscular tissue, though of its ordinary colour, had become as hard as a dice box; and Broussais compares a heart thus indurated to a cocoa-nut. This morbid alteration may, according to Bouillaud, exist in a portion of the organ, in any degree up to the actual conversion into cartilage or bone. The septum and columnæ carneæ are the parts most exempt from this change; yet some of the latter have occasionally been found indurated, being converted into a yellowish-white substance, like fibro-cartilaginous tissue; whilst others, close to them, may have been, on the contrary, in a state of unnatural softness. Corvisart has given a very remarkable case in which the apex of the heart, in its whole thickness, and for some way upwards, was converted into cartilage, the columnæ carneæ of the left ventricle having nearly an equal degree of density. The disease had obviously commenced by an inflammatory attack within the chest about eighteen months before its fatal termination. M. Rénaudin has related the case of a law student of thirty-three years of age, in whom the wall of the left ventricle was so penetrated with osseous particles, as were likewise the columnæ carneæ, as to resemble a petrefaction. In this case there had been, in addition to great pain on pressure, palpitations, dropsical swellings, and other ordinary symptoms of heart-disease. Mr. Smith has recorded an example to which we shall again have occasion to allude more at length, of very extensive ossification on the external surface of the heart, which appeared to have commenced, as is probably commonly the case, in inflammatory false membranes formed between the two serous surfaces of the pericardium; and similar cases are to be found in Baillie, Burns, Laennec, Adams, and others. It is possible that such osseous deposition occasionally commences also, not only in the sub-serous cellular tissue, when in a state of chronic inflammation, but, moreover, in that connecting the muscular fibres, and comes eventually, as it increases in quantity, to encroach materially on, and eventually to displace more or less of, the muscular substance. Ossification of the whole heart is obviously impossible.

Whether *gangrene* of the heart is to be admitted amongst the possible results of its inflammation has been much disputed, it appearing to many inconceivable how life could be sustained long enough for its production in the case of an inflammation of such intensity so situated. Yet Bouillaud inclines to the affirmative; and it appears to us, that its occurrence, in a patch of limited surface and depth, is not to be rejected as beyond the limits of credibility. Corvisart thought that, like senile gangrene of other parts, it occasionally originated in a state of general debility. We are not, however, aware of any well authenticated instance of it

as yet on record: most of the cases in which it has been said to exist appear obviously to have been examples of cadaveric decomposition favoured by a depraved state of the solids and fluids—such, for instance, as is met with in putrid fevers.

Inflammation of the muscular substance of the heart has probably never yet been met with in a perfectly simple state; either pericarditis or endocarditis seeming invariably to complicate it. Corvisart was of opinion, that it for the most part assumed a very chronic character, in which, its symptoms being peculiarly obscure, it was commonly latent; and the substance of the organ, in nearly all the cases adduced by him, was of an unnaturally pale colour and soft texture. It is possible that some of the cases in which purulent deposits have been discovered within the walls of the heart, have had their origin, not in the local inflammation of this organ, but rather in the transfer of the matter, so found, from some other part of the body in a state of suppuration or abscess: and it is only by an accurate examination of the surrounding portion of its structure, and a careful consideration of previous symptoms, that a correct conclusion can be arrived at.

Many recent writers are disposed to consider *rapid hypertrophy* of the heart, also as one amongst the forms or consequences of sub-acute or chronic carditis.

Symptoms of Carditis. As to the symptoms of inflammation of the substance of the heart, as distinguished from those of its lining membranes, nothing satisfactory has yet been ascertained, in consequence of its having hitherto been observed only in combination with the latter. Neither Corvisart, Laennec, nor Bouillaud, have attempted their diagnosis. The last-named author limits himself to stating his belief that the complication of acute carditis aggravates in the highest degree inflammation of the endocardium and pericardium. It has been supposed that the pain in the heart, which is augmented by pressure between the ribs and in the epigastric region, is of a peculiarly severe and lacerating or burning character, where the muscular structure is engaged; and the suffering has been said to be aggravated remarkably with each contraction of the organ. Mr. Stanley's case, however, shows that these signs are by no means universal. Greater violence of the palpitations, more marked intermissions of the pulse, which has been asserted to be generally small and weak, universal tremors, inexpressible anguish, constant jactitation, and extreme proneness to syncope, though occasionally dwelt upon as distinctive, will prove equally fallacious; being participated in, as we have seen, by very acute cases of the membranous inflammation of the organ.

It has been suspected, not without some show of probability, that the extreme rapidity of pulse in the convalescences from some fevers, especially those of an adynamic character, may be occasionally connected with an inflammatory softening of the heart. The action of the heart in the cases in question is commonly extremely feeble, both as judged of by its impulse and by its sounds, and by the great tendency to syncope; circumstances, however, which, taken alone, cannot be considered by any means decisive, as they are equally observed in cases of very abundant pericardial effusion. Recourse to the results of percussion and to the application of the stethoscope over the track of the great vessels, may sometimes enable us to decide as to the true nature of the disorder.

There are no symptoms yet known by which abscess or ulceration within the walls of the heart can be certainly recognised, and the diagnosis of aneurismal tumour of the organ is no less obscure. Indeed, any of the three may exist, without exciting even a suspicion of their presence. The fatal illness of the celebrated Talma, which took place about twelve years ago, when we happened to be in Paris, and the nature of which, during his latter days, was the subject of daily conversation amongst the most distinguished of the medical professors (some of whom were in actual attendance on him,) afforded a remarkable exemplification of the obscurity spoken of; for, notwithstanding the exquisite tact in diagnosis for which the French school is so justly famous, the obstruction of the bowels, of which he died, absorbed all attention, and the cardiac aneurism, afterwards discovered on dissection, was never, that we can recollect, even once hinted at.

It is possible, however, that percussion and auscultation may eventually put us in possession of some physical signs by which this lesion may be detected; at least, in cases where it has attained to a considerable magnitude. Unnatural extent of dulness, and perhaps, in some instances, prominence of the præcordial region, and a thrill or a peculiar sound produced by the blood passing through the aperture of communication, are the kind of evidences which have been suggested as of probable occurrence.

Into the *causes* and *treatment* of carditis it is unnecessary to enter, as they are altogether identical with those of pericarditis and endocarditis, its usual associates, of which we have already spoken at considerable length in a former page.

HYPERTROPHY OF THE HEART.

Nature and Causes.—Forms.—Anatomical characters.—Physical signs.—General symptoms.—Complications and secondary affections.—Supposed causes of each form of Hypertrophy.—Duration and prognosis.—Treatment.

Of all the affections to which the heart is liable, its *enlargement* is that which, from the obviousness of its anatomical character, the prominence of its symptoms, and the frequency of its occurrence, first attracted the attention of pathologists, and became, as it were, the type of cardiac disease. Its fatal tendency when left uncontrolled, and the variety of complications along with which it presents itself, either as a consequence, concomitant, or cause, must ever cause it to occupy a very prominent place in all treatises on disorders of the heart. It may evidently have two sources,—either augmentation of the solid matter of the heart from disproportionately increased nutrition, or expansion of its cavities,—giving rise respectively to the two denominations of *Hypertrophy* and *Dilatation*; the one being a disease of an active, the other comparatively of a passive nature. Their exciting cause is, indeed, often the same, viz., an increased demand on the exertions of the heart (from obstruction in the course of the circulation and other sources,) the result varying with the vital properties of the muscular parietes of the organ, and with the general strength or debility of the system. Where the constitution is naturally robust, and the structure of the heart, in particular, is strong and well supplied with rich and stimulating blood, and its ordinary action consequently is energetic, larger demands on the exertion of the organ will be followed, according to a well known law of muscular development, (exemplified in the brawny arm of the professor of gymnastics, the fencing master, or the blacksmith, and in the lower limbs of the porter and opera dancer,) by an augmentation of bulk and power; a large afflux of the nutritious fluid being the consequence of the constant and vigorous exercise of the part. This rule, indeed, holds good in an especial manner with respect to the heart, as the coronary arteries, by which it is fed, receive the first and fullest effects of the augmented force of the circulation.

This local increase of nutrition may soon be carried to such a length as to put the affected muscle quite out of due relation to the other parts of the system. In the case of the heart, which stands in such close connexion with every portion of the body,—its condition determining in a great degree the quantity of blood which is to circulate through each part, its force and rapidity, and even the permanent increase in bulk and density of all the organs,—such an accession of power cannot fail to be often productive of very serious pathological results.

When the habit of body is, on the contrary, naturally weakly, or deeply debilitated by disease, and when the fibre of the heart itself is relaxed and yielding,

and capable of little reaction,—obstruction or regurgitation, and consequent accumulation of blood, tend only to distend the walls and enlarge the cavities, without giving rise to the deposition of any proportional addition of solid material.

It was the dilatation of the heart which seems first and chiefly to have attracted the attention of the earlier pathologists; the augmentation of its substance being commonly overlooked, or only viewed in subservience to its increased capacity. Even Corvisart, to whose clear and powerful mind we owe the removal of so many prejudices in respect to this class of diseases, was biased in the formation of his nomenclature by the prevalent error. His division of enlargements of the heart into *active* and *passive aneurism* still exerts an injurious influence on practice; for the increased efficiency of an organ, and its capability of enduring debilitating measures, is often very far from being commensurate with its increased bulk or substance. In thus massing all enlargements of this viscus under the general term of aneurism, he was guided by an erroneous analogy. Under the influence of this false generalization, he has not only placed in a deceptive aspect some of the morbid states which he has so vividly portrayed, but been led, moreover, to overlook other pathological conditions of equally real, though less frequent occurrence. M. Bertin was the first to insist on the necessity of considering apart the thickening of the muscular parietes and the dilatation of the cavities; these being in their nature, though so often complicated together, two totally distinct morbid conditions; and also to maintain that this thickening was not ordinarily dependent on the deposition of morbid matter, as Lancisi and the older pathologists, and even Portal and other comparatively recent authorities, had asserted, but merely on an increased nutrition of the part. These juster views naturally led him to a more philosophical and correct classification, and to the recognition of forms of disease which had previously escaped notice, as well as to a more discriminating mode of treatment.

Forms. Three forms of hypertrophy of the heart are recognised by M. Bertin,—viz., the *simple*, the *eccentric*, and the *concentric*. Dr. Hope's division of the varieties of hypertrophy, slightly modified from the classification of Laennec, is into *simple hypertrophy*, *hypertrophy with dilatation*, and *hypertrophy with contraction*, thus coinciding exactly in principle with that just stated; whilst the terms in which it is worded are perhaps preferable, as being simpler, and less liable to misconception. Dr. Williams also treats of the varieties of this affection under nearly the same titles,—viz., *simple*, *dilated*, and *contracted hypertrophy*.

In each there is an increase of substance in the walls of one or more of the cavities of the heart; but in the first, these cavities themselves remain of their natural size; in the second, they are enlarged; and in the third, on the contrary, diminished. This last variety, in which the deposition of new matter takes place chiefly towards the inner surface of the heart, though really less uncommon than the first or simple species, had previously altogether escaped observation. Yet the frequent existence of an analogous condition of other hollow muscular organs should have prepared us to expect it. The bulk of the heart must, however, be as large or larger than natural, at the same time that its walls seem thickened, to warrant us in asserting the presence of this variety of hypertrophy; for great contraction of the muscular fibres, such as often takes place after death, especially when somewhat sudden, the individual having been previously in vigorous health, may give rise to an appearance of thickening, which might otherwise readily be confounded with the morbid alteration in question. M. Cruveilhier, indeed, and Dr. Budd will scarcely admit the reality of concentric hypertrophy under any limitations, save as a congenital affection; believing that all the cases given as such in books either fall under the exceptional category just spoken of, or, if cardiac symptoms existed during life, were examples of simple or slightly dilated hypertrophy, with or without valvular disease; and that the shrinking of the cavity was merely a passing condition originating at or after death. In support of this view, the latter writer adduces apparent examples of this affection, in which he was able, with very slight force, to dilate the contracted cavity; and he farther

asserts that none of the effects usually connected with obstruction have been present, unless obstacle of some other kind, sufficient to account for them, co-existed. His arguments, at the least, prove satisfactorily, that cases have often been mistaken for concentric hypertrophy, which had no title to the appellation.

Instances of simple hypertrophy of the heart had long since been recorded by Morgagni, Burserius, and even by Corvisart himself, but without suggesting to any of them the correcter general views with which the name of Bertin has become associated.

It seems to be the opinion of Bouillaud, that hypertrophy of the heart rarely exists unconnected with some of the other affections of the organ already enumerated; more especially with inflammation of its outer or inner linings, disease of the valves, narrowing of the orifices, or obstruction in the great vessels. The obstacle to the circulation from these lesions are, according to him, the great source of all the symptoms usually ascribed to hypertrophy. This, however, was not the opinion of Laennec, who laid much less stress on the supposed obstruction, as a cause of the derangement of the functions, than either the authors just named, or even than Corvisart. Ossification of the valves, in particular, he held to be a much rarer affection than hypertrophy; and he believed, moreover, that the degree of obstruction ordinarily so produced, seldom affected the health, unless enlargement of the heart had supervened. Dr. Clendinning, too, has recently impugned the correctness of Bouillaud's views, and adduced a very great number of cases to show that hypertrophy of the heart, uncombined with any of the morbid states alluded to above, is of very frequent occurrence. Of upwards of five hundred dissections made by him of patients dying in the institution to which he is attached, where all kinds of disease, curable or incurable, are indiscriminately admitted, above one hundred and seventy—that is, about the third of the whole—proved to have had heart-disease in some form. Five-sixths of these were cases of hypertrophy, uncomplicated, he assures us, with other diseases of the heart, such as pericarditis, endocarditis, or valvular disease. In about thirty cases only, or one-sixth of the whole, well-marked valvular disease was detected,—combined, it is admitted, in every instance but one, with obvious hypertrophy. Dr. Hope, while he fully admits, with Bouillaud, that valvular disease is a very frequent cause of hypertrophy and dilatation, yet agrees with Dr. Clendinning in considering the alteration in the muscular structure of the organ as the chief element in the production of the distressing symptoms; inasmuch as, commonly, it is not until this latter has been superinduced, that the embarrassment of the circulation and the patient's sufferings become very considerable; and it is, moreover, chiefly on the prevention or treatment of these abnormal muscular conditions that our hopes of alleviation are based in the advanced stages of valvular lesion.

The normal average weight of the heart, in the male subject, as we have seen, is estimated by Dr. Clendinning at about nine ounces.* In several cases, hypertrophy was proved, by recourse to the balance, to exist, though it was not obvious to the eye,—as, for instance, when the heart weighed about eleven or twelve ounces. The average weight of eighty diseased hearts of males was, however, much more than this,—namely, fifteen ounces, or two-fifths more than the healthy standard. Even where diseased valves and hypertrophy co-exist, Dr. Clendinning sees no proof of the antecedence of the former. His belief is, that the hypertrophy results exclusively from vital and not from mechanical causes, and is in its turn the source of an augmented tendency to inflammation throughout the body generally, and in the heart itself no less than in other parts; and that the valvular lesion, in conformity with this view, is often the consequence rather than the cause of hypertrophy. “I would thus,” he continues, “in a great degree, reverse the

* The natural average weight of the heart varies with the age. Thus, in the prime of life, it falls slightly below the weight stated in the text, whilst, in old age, it may exceed it by half an ounce or so.—AUTHOR.

order of causation usually received, and attribute much of the valvular disease to inflammation, mainly induced, (if rheumatism be excluded) by previous hypertrophy as a most potent predisposing cause." To this opinion he has been led, by observing that, in the great majority of cases of morbus cordis, no valvular disease exists; whilst, on the other hand, he has never but once met with this last named lesion, unless where hypertrophy was also present. Hypertrophy and inflammation, according to the same authority, are only different stages or degrees of the same process; accordingly, a large proportion of cases of disease of the heart, are hurried off by the supervention of pericarditis or endocarditis in their advanced period.

Anatomical characters. In hypertrophy of the heart, the muscular tissue is commonly of a deeper red, and more richly supplied with blood than natural, its coronary arteries are enlarged, and its density and firmness increased. In a very advanced stage, a state of induration in some cases, and of ramollissement in others, are occasionally observed. It occurs very commonly as one of the sequelæ to acute rheumatism, and frequently in connexion with evident traces of inflammation of the interior or exterior lining membranes. Such are the appearances which have inclined Andral, Bouillaud, Elliotson, and other recent writers, to a belief in the frequent inflammatory origin of the affection. That its source may be occasionally of this nature, we are not prepared to deny; but believe that in the great majority of cases the increased bulk and firmness in the organ are the result merely of greater activity in the nutritive process, in consequence of a more abundant determination of blood from the greater demands made on its exertions. Whatever unduly and habitually excites the heart, or renders the performance of its ordinary task more difficult, whether the hindrance be seated in the heart itself, or extrinsic to it, must necessarily have this tendency, provided the vitality of the organ be unimpeached by any general or local debility.

Of all the forms of hypertrophy, that *with dilatation*, corresponding with the *active aneurism* of the heart of Corvisart, is the most frequent; next to it is that *with contraction* or diminution of the cavities; whilst that in which they remain *unaltered* in size appears to be the rarest of all. When the cavities are enlarged, there must obviously be an increase of substance in the parietes, provided they still retain even their natural thickness. It is not very usual to find but a single compartment affected: this, however, is sometimes the case. The left ventricle, from its greater energy and power of reaction, the greater task which it has to fulfil in driving the blood through the circuit of the general circulation, and the more frequent impediments which it has to overcome, is the cavity in which this change is most apt to occur, and in which it most commonly runs to the greatest excess.

In the right ventricle, hypertrophy is much rarer: when it exists in a well-marked manner, the ventricle no longer collapses, as in the natural state, on being emptied.

Hypertrophy of the left ventricle often co-exists with the same condition of the right, and sometimes with its simple dilatation.

The size of the cavity of the ventricles is subject to a considerable range in hypertrophy; being sometimes so distended as to be capable of containing the fist, or, if in the other extreme, so contracted as scarcely to hold the shell of an almond. When dilatation takes place, it may be either in a longitudinal direction, giving to the heart an elongated form, or, as is much more common, transversely, rendering it strikingly globular.

The thickness of the parietes of the left ventricle is sometimes carried to considerably above an inch; that of the right to four or five lines, and, in some very rare instances, even to more than double or treble that thickness, as sometimes in cases of open foramen ovale.

The instances in which the heart attains to the greatest magnitude, are those where *dilatation and hypertrophy* are combined; and here it is occasionally twice, or even thrice, its natural size. It is when both ventricles are thus at once so affected, that the organ becomes most remarkably rounded, the apex being in a

manner obliterated, and that it assumes a transverse position in the chest, occupying a very considerable portion of the thoracic cavity, occasionally descending as low as the eighth rib, displacing the lungs, especially that of the left side, and thrusting it up as high as the third rib. Where adhesions have taken place between the heart and the pericardium, and between the latter and the parietes of the chest, the organ as it enlarges is prevented from descending as it otherwise would do; and it is here, as has been remarked by Dr. Hope, that the cartilages of the ribs are most apt to become prominent.

When the left ventricle is much enlarged, whilst the right retains its natural dimensions, the latter has the appearance of a mere appendage let into the side of the former; when, on the other hand, the right ventricle is solely or chiefly hypertrophied, it descends unusually low, and may form the entire apex of the organ.

In simple and dilated hypertrophy, the thickness of the walls ordinarily increases gradually from the apex to beyond the middle of the ventricle, diminishing thence somewhat abruptly towards the great arterial orifices,—being thus, as it were, a mere exaggeration of the natural state; whilst in the concentric variety, on the contrary, the deposition seems to take place more equably over the interior, inclusive of the apex, to which it gives a very blunt form.

In some instances, the augmented deposition in the walls takes place in a very irregular or partial manner, some parts appearing thicker and others thinner than natural. The columnæ carneæ generally participate in the affection of the parietes; yet, where the cavity is much enlarged, they sometimes may appear, from their elongation, rather attenuated. The septum is, for the most part, much less affected than the exterior walls; yet in some rare cases it is alone thickened, as may likewise be the case with the columnæ carneæ. The cavity of the right ventricle has been found almost entirely filled up from the latter cause, the enlarged fleshy columns becoming mutually adherent at their adjacent points, and thus forming a complicated muscular net-work, which must have considerably impeded the motion of the blood.

The parietes of the *auricles*, or rather their muscoli pectinati, and especially those of the right, are also occasionally the seat of thickening; but this is scarcely ever observed without a coincident dilatation of their cavity; and very seldom, indeed, without the co-existence of enlargement or hypertrophy of the ventricles.

The weight of the heart, when considerably enlarged, may be raised to twice or thrice what it is in the natural condition, as we have already mentioned with more detail in the introduction. (See p. 448.)

The *symptoms* of hypertrophy of the heart are either local or general; and it is only from the combined study of both, that we can determine with any certainty the existence of the affection in the earlier and, practically speaking, the most important period. Exclusive attention to the physical signs has been emphatically deprecated by Laennec and all the most judicious of his followers as tending only to bring them into disrepute, and often to lead the physician into lamentable error.

Of the *local symptoms*, or *physical signs*, the one which earliest attracts our attention is the great increase in the force of the heart's pulsations, and of the extent over which they may be felt or seen. On applying the stethoscope, the ear is forcibly thrown up by a gradually heaving motion, and over an unusually large space, extending occasionally, if the enlargement of the heart be extreme, from the third to the seventh or eighth rib; the whole mass of the enlarged organ seeming to come into contact with the thoracic parietes at each pulsation (the apex beating generally more to the left side, as well as at a lower level than natural,) and then falling back, with a subsequent jog or shock at the end, called "the back stroke" or "diastolic impulse" by Dr. Hope, and ascribed to the refilling of the ventricles. The first sound of the heart is remarkably diminished in intensity, of a dull prolonged character, and audible only within a narrow sphere, provided the dilatation, if any exist, bears but a slight comparison to the degree of hypertrophy present; for the thickened muscular mass is but ill adapted, as already explained, for the

production or transmission of sonorous vibrations. Where, however, much dilatation co-exists with the hypertrophy, the sound is by no means thus impaired, but may be heard over a very extended surface in front, and occasionally even in the posterior portion of the chest; the impulse being strong, sharp, and hammer-like, somewhat as in nervous palpitations, instead of having the prolonged heaving motion characteristic of the purer form of hypertrophy. The *second sound* is little altered from its natural state in the simple variety when moderate in degree; it is generally diminished in the concentric, and augmented in the dilated, species. When the natural cardiac sounds are obscured in the præcordial region by a râle or a bellows-murmur, they may occasionally still be heard distinctly towards the top of the sternum or under the clavicles. The period of repose is much encroached on by the time consumed in the systole.

The pulsations of the heart, in the earlier part of the disorder, when not excited by any extraneous cause, are not ordinarily augmented in frequency; nor yet, if there be no contraction of the orifice, nor valvular disease, nor great dyspnœa or debility, are they irregular. The sense of palpitation, or rather a consciousness of the heart's action, is more constant in this than in other forms of heart-disease; but the palpitations rarely attain to such violence as is observed in cases of valvular lesion and pericardial adhesions, except as a temporary consequence of some unusual exertion or strong mental emotion. Where palpitations have thus been excited, a bellows-sound is occasionally heard during their continuance; but where this phenomenon is permanent, it may be considered an almost infallible index of the co-existence of organic obstruction from disease of some of the valves or orifices.

When the impulse and dulness of the first sound are more remarkable under the sternum, than under the cartilages of the ribs, Laennec thought the existence of hypertrophy of the right ventricle might be looked on as almost certain,—a reservation being made in favour of those cases of extreme enlargement of the left ventricle from the co-existence of hypertrophy and dilatation, in which this part of the heart may extend itself beneath the sternum.

In order to arrive at a valid conclusion from the stethoscopic signs, they must, as we have already intimated, be investigated at such times as the heart's action is neither unusually excited nor depressed. Low diet, previous loss of blood, or evacuations of any kind, or the oppressive dyspnœa attending certain stages of pulmonary affections, may so enfeeble the movements of even a greatly over-grown heart, as to render such an examination quite nugatory. Hence the propriety of auscultating repeatedly, and, under every variety of circumstances, is in all dubious cases obvious.

On percussion, a considerable extent of dulness is commonly recognised, commensurate with the augmented size of the organ, and consequently most considerable in those cases where the size of the cavities, as well as the substance of the organ, are greatly increased. Certain states of the lungs and cavity of the chest may, however, as already mentioned in the introductory remarks, interfere with the existence or value of this sign. (See p. 446.)

Prominence of the præcordial region, and an increased breadth of the corresponding intercostal spaces, are sometimes observable; and this appears to be especially the case when extensive pericardial adhesions exist, and in children, in whom the parietes are more yielding. An uneasy sensation, a feeling of weight, or a dull pain, is occasionally felt in the situation of the heart.

General symptoms. In simple hypertrophy of the left ventricle, and also in those cases where thickening predominates over co-existing dilatation, if no narrowing of the orifices nor valvular or aortic disease is present, the *pulse* is strong, full, and tensely prolonged under the finger in consequence of the protracted systole of the over-grown ventricle, but at the same time regular. With these characters of the arterial pulse, a thrill is occasionally associated; but, as it appears to Dr. Hope, only in those instances where anæmia has been super-induced, all cases of obstruction and regurgitant lesions being for the present

excluded from our consideration. In concentric or contracted hypertrophy, likewise, the pulse is tense and throbbing; but, in consequence of a smaller wave of blood being emitted at each systole of the heart, it is necessarily smaller than in the preceding instances.

Hypertrophy, as distinguished from dilatation and other lesions causing impediment to the circulation, is farther characterized—at least, in its earlier stages—by greater activity of the capillaries, a more highly arterialized blood, a brighter eye, and a more brilliant complexion, provided the colour was naturally florid. Thus, in the incipient period, the functions of the body, as Bertin remarks, are not necessarily at all impaired; on the contrary, they appear rather to be executed with increased energy, and there is, in general, a fallacious show of high health and vigour. At a somewhat more advanced period, there are frequent flushings, with marked tendency to active hæmorrhages of the brain and mucous membranes. These latter, when they take place from the Schneiderian membrane, or from the hæmorrhoidal or other vessels of the intestines, to only a moderate extent, must be considered as exercising a salutary influence over the complaint. Hæmoptysis is likewise a frequent symptom, and perhaps more especially when the right ventricle is affected. The augmented volume of the heart may, by encroaching on the lung, in some degree interfere with its function; yet the respiration is, for the most part, much less early or severely compromised than in cases of simple or passive dilatation, or other lesions tending directly to impede the circulation; and at the same time the tendency to venous congestion and serous effusion throughout the body supervenes much more tardily. If, however, these cases be not cut off in their progress, as is often the case, by a sudden arrest of the heart's action, or by apoplexy, or inflammation of the lungs or some other organ (the inflammatory diathesis being strongly marked,) engorgement of the capillaries both of the lungs and of the general circulation eventually takes place; and it becomes at length evident that such patients have no special or complete immunity from cough, dyspnoea, and other pulmonary symptoms, nor yet from dropsies of the cellular membrane and great cavities. These secondary affections are here, however, of a somewhat less inveterate character, and more susceptible of alleviation by judicious treatment, than where they originate in obstruction. The œdema connected with hypertrophy, Dr. Hope remarks, usually makes its first appearance in the face, in consequence of the naturally very copious supply of blood to the head, and its proximity to the heart, in virtue of which it receives the full force of its morbidly vehement contractions.

A slight tendency to difficulty of breathing on unusual exertion may sometimes be noticed, even from a very early period. This is especially felt at the commencement of any great muscular effort, diminishing in some degree as the body gets warm, the blood becoming determined to the surface, and the cutaneous exhalation augmented.*

* This phenomenon of "the second breath," or "getting into wind," as it is called, is well known to all who practice athletic exercises, trainers of horses for the course, &c. The writer of this had himself practical experience of it in a remarkable degree, in ascending *Ætna* on foot at an early period of the year, when the sides of the mountain were still covered with frozen snow to a distance of upwards of twelve miles from the summit. The ascent of this slippery inclined plane, extremely fatiguing even to one at the time accustomed to considerable pedestrian exertions, gave rise, during the first two or three miles, to a very painful acceleration of the respiration and pulse; the heart throbbing with such violence as if it would burst through the side, or cause instant death; yet, under the forced continuance of the exertion (and any relaxation would have been perilous, on account of the intensity of the cold) this oppressive sensation gradually declined; and after many hours of almost incessant smart walking and running, the starting point at the foot of the mountain was regained much less with feeling of fatigue than had been experienced during the first mile of the ascent.—
AUTHOR.

Though hypertrophy of the heart may almost always be recognised by a careful consideration of all the physical and general signs, it is not possible, in every instance, to say which cavity is chiefly affected. Most of the signs hitherto detailed, apply more particularly to hypertrophy of the left ventricle. Where it is greatly augmented in bulk, its enlargement is, indeed, very usually complicated with a similar affection of the other cavities. If, however, as is sometimes the case, the right ventricle is alone or chiefly affected, the increased dulness and impulse is most conspicuous under the lower part of the sternum, and the pulse has not necessarily the peculiar characters above detailed; whilst, on the other hand, there has commonly been thought to be a greater tendency to dyspnoea and hæmorrhages from the lungs (hæmoptysis, pulmonary apoplexy,* &c.) When the cavity is at the same time dilated, and its valves, from this or any other cause, insufficient, there will be regurgitation and jugular pulsation synchronous with the ventricular systole. From such an impulse as is occasionally transmitted to the vein by the carotid, this may be distinguished by being confined chiefly to the lower part of the neck, where the two vessels are far apart. Pressure on the upper part of the vessel, again, does not interfere with it. It disappears in some during inspiration, and is most conspicuous during expiration. The pulsation of the jugulars, as remarked by Dr. Hope, is sometimes obviously double; the first motion corresponding to the contraction of the auricle, the second to the ventricular systole. Where there is simply impediment to the onward current, without actual reflux, there will be merely a dilated condition of these vessels.†

As to the *auricles*, we are not yet in possession of any unequivocal signs of their increased strength or enlargement, distinct from those of similar states of their respective ventricles; but with these they so frequently co-exist, as to render their separate diagnosis matter of curiosity, rather than of practical interest. Percussion may sometimes, however, lead to a very strong suspicion, at least, of their enlargement where it exists in a marked degree; and the presence of a venous pulsation anticipating the ventricular systole might serve, in the case of the right ventricle, to confirm such suspicion.

In respect to the *wasting away of the eye*, or its inflammatory destruction, adduced by Testa, on the faith of a single case, amongst the occasional consequences of disease of the heart, the latter is so common, and the former so extremely rare an affection, as greatly to discredit the supposed connexion; and the same may be said of gangrene of the limbs, which has sometimes been supposed to be a symptom of enlargement of the heart, on the authority of an old case in Fabricius de Hilden and two comparatively recent ones by Giraud, a contemporary of Corvisart. Whenever gangrene of the extremities does co-exist with disease of the heart, it has been rendered probable, by the examinations by M. Bouillaud and Dr. Carswell, that it is connected immediately, not with the cardiac affection, but with local obstruction by a coagulum in the artery leading to the part. Whether, however, this obstruction is the cause or the consequence of the gangrene, is not to us so evident; for where the capillaries, from any circumstance, lose their vitality, impediment to the circulation and coagulation of the blood in the trunk by which they are supplied, seems an inevitable result. Mor-

* Pulmonary apoplexy occurs more frequently, according to Dr. Hope's and Dr. Wilson's experience, in connexion with great contraction of the *mitral valve*, with or even without hypertrophy and dilatation of the right ventricle, than under any other circumstances.—AUTHOR.

† A jugular pulsation synchronous with the ventricular systole, and, as is so often the case, unaccompanied by "soufflet," is not considered by Dr. Hope as satisfactory evidence of actual regurgitation through the tricuspid valve; as he believes that an impulse fully adequate to the effect may, when the heart is enlarged and acting impetuously, be transmitted by the mere recoil of the valve against the column of the blood behind it,—and this especially when both the valve and orifice are increased in size, and the veins congested.—AUTHOR.

tification of a limb occurring in connexion with a diseased heart, may, in some cases, moreover, depend merely on the pressure on the vessels and on the inflammation induced by the excessive effusion of serum into the cellular tissue.

Complications and secondary affections. Several of the complications met with in the course of hypertrophy of the heart, as, for instance, inflammation of the inner and outer linings of the organ, obstruction of the orifices, disease of the valves, aneurism of the aorta, serous and hæmorrhagic effusions, &c., have been alluded to in the preceding paragraphs. There are, however, some others which, their connexion being less universally acknowledged, merit a more particular consideration; we refer especially to *general visceral enlargement* and to *apoplexy*.

Hypertrophy being characterized during the greater part of its progress by increased activity of the circulation, that there should ensue enlargement of the body generally, and more especially of the internal viscera thus profusely supplied with blood, and that, too, generally of a rich and highly reparative quality, is not surprising. That an increase of bulk takes place in such cases, more especially in the spongy organs, as the liver and spleen, had, indeed, long been known, and is specially mentioned by Lieutaud, Corvisart, Portal, Kreysig, Testa, and others; but was by many viewed rather as the cause than the consequence of the disease of the heart; and even where the true nature of the relation was recognised, the enlargement was very commonly ascribed to mere vascular repletion, or to infiltration. Dr. Clendinning has, however, very recently demonstrated, as already noticed in our introductory remarks on disease of the heart, that even after incising the viscera, and draining off their fluid, there still remains a notable augmentation of weight as well as of bulk, indicating clearly that they have been the seat of an unusual active process of nutrition; and this he has found to hold good, not only of the two organs just specified, but also of the stomach, intestines, pancreas, kidneys (which last are sometimes, moreover, the seat of the peculiar affection described by Dr. Bright,) of the lungs, especially the bronchial ramifications, and even of the brain. And this increase of substance, it was farther stated, is not limited, as we should perhaps have expected, to cases of active enlargement of the heart, but occurs in all varieties of heart-disease, whether of an active, or passive, or obstructive nature, where the organ is enlarged, and the vascular system generally is kept in a state of abnormal repletion; so that it would appear, as he remarks, that even a comparatively stagnant or venous blood is adequate to the production of the effect in question.

Hypertrophy of the heart, as is justly remarked by the same author, does not necessarily imply an increase of efficient power; but rather tends, on the contrary, to induce deficient functional aptitude, as becomes evident towards the winding up of the disease,—the symptoms of dilatation at last beginning to predominate over those of hypertrophy, and the pulse often becoming soft and compressible.

The influence of hypertrophy of the heart, in the aggravation of other diseases originating during its course, is very conspicuous. The prognosis in all pulmonary affections (phthisis, pneumonia, bronchitis, &c.) in cerebral diseases (apoplexy, delirium tremens, and mania,) as also in abdominal inflammations and fever, is rendered much more unfavourable by its presence. To many of these diseases, it moreover disposes in a peculiar degree; and more especially to chronic bronchitis, emphysema of the lungs, and to the asthmatic paroxysms generally immediately dependent on one or other of these morbid conditions; and also to softening of the brain and cerebral hæmorrhage; to brain fevers, inveterate headaches exasperated by stooping, nervous irritability, frequent ophthalmia with sparks and flashes before the eyes, ringing in the ears, and other minor evidences of determination of blood in undue quantity to the head.

The dependence of *apoplexy* on disease of the heart, to which attention was many years since called by Legallois and Richerand, and more recently by Adams, Lallemand, Johnson, Brichteau, and Hope; and of which, indeed, even Lancisi, Baglivi, and others of the older pathologists seem to have been quite aware; may

now be considered as one of the best established medical facts. In a large number of cases of hypertrophy of the heart, examined after death by Dr. Clendinning, apoplexy co-existed in three-sevenths of the whole. Dr. Hope believes that the majority of cases of cerebral hæmorrhage have this origin, and agrees with Bertin and Richerand in ascribing to it more influence than even to the so-called apoplectic constitution.* Dr. Kellie and M. Rochoux have, as we are aware, endeavoured to discredit the connexion alluded to; but the number of positive facts in its favour is too great to allow us to doubt of its reality. The ill effects on the brain appear to be, in some degree, counteracted by the occasional existence of narrowing of the aortic orifice, as has been pointed out by Bricheteau; but less so than we might expect, unless where the contraction is very considerable: and then the lungs are still more affected, and the tendency to serous effusions is more prominent. The thickening of the left ventricle is much more apt, it is supposed, to determine a cerebral hæmorrhage in those cases where ossification of the arteries within the head exists; a morbid condition, on the importance of which the late Dr. Baillie strongly insisted, in respect to its bearing on apoplexy; but in regard to which Dr. Cheyne, in an able treatise on this disease, has, as we were surprised to find, expressed a different opinion.

Causes of each form of hypertrophy. Concentric hypertrophy, or that with contraction of the cavity, has been supposed occasionally to originate in inflammation of its internal lining membrane, by means of which an increased stimulus is imparted to the nutrient vessels of the adjacent muscular layers; simple hypertrophy, or that in which the dimensions of the cavity are unaltered, to a similar action transmitted from the external or pericardial covering to the more superficial muscular fibres; whilst in those cases where there is great dilatation, as well as increase of substance, an inflammatory and obstructive agency would seem very often to be simultaneously concerned.

The very frequent co-existence of hypertrophy with endocarditis or pericarditis, to which we have so repeatedly alluded, and the analogy of the augmented growth taking place in the walls of other hollow muscles, as the bladder, stomach, or intestines, from a long continued inflammatory condition of their lining membrane, seem to favour this view. Indeed, the analogy might be pursued still farther, by observing that, in these cases, likewise, an obstruction to the free course of the contained matters often exists, and forms an additional link in the chain of causes and effects; giving rise, in some cases, to dilatation, and in others to contraction, of the viscus. It is, however, at the same time, almost certain that the increased muscular growth is not unfrequently a primary affection, occurring from excessive exertion of the organ, from the congenital preponderance of its power in relation to the rest of the system, or from some disproportion amongst its parts. Rheumatism, though it so generally makes its first attacks on its lining membranes, yet occasionally seems to act primarily, and almost exclusively, in the production of hypertrophy of the muscular tissue.

All violent exercises, if disproportioned to the strength, and especially during the period of growth—frequent and strong mental emotions—plethora—venereal excesses, or other causes giving rise to habitual palpitations—obstructions in the lungs or great vessels, and more especially aneurism of the aorta, and whatever makes unusual demands on the exertions of the heart,—necessarily tend, in the manner and under the circumstances specified in the commencement of this article, to produce increased nutrition of the organ, and along with this, most commonly, enlargement of its cavities. We may add here, that as the tendency of obstruction in a heart capable of struggling effectually therewith, is to produce hypertrophy, so the *constant over-distention* of the cavities, connected with permanent

* This influence is participated in, Dr. Hope is persuaded, by various other affections of the heart, as dilatation, softening, disease of the valves, &c.; inasmuch as they tend to produce congestion of the brain.—AUTHOR.

patescence of an orifice and reflux, and other causes, has appeared rather to lead to the predominance of dilatation.*

A preternatural communication between the right and left sides of the heart is often accompanied by hypertrophy of the right ventricle, and this has been ascribed to the admission of the arterial blood into it; though it is more probably, for the most part, an original condition bearing a direct relation to its abnormal participation in the general circulation, and the unusual demand on its exertions.

Hypertrophy of the heart, whatever may be its origin, must obviously, from the constant over-action of the organ, put it in a state favourable to the development of inflammation in its lining surfaces, and more especially of that in contact with the blood, and which covers the valves and orifices; and thus Pericarditis and Endocarditis, though so often the cause, may frequently also be the effect, of enlargement of the organ.

Duration and prognosis. The shortest period within which this disease can develop itself, is uncertain. Though ordinarily an affection of many years' duration, yet it has, in some very rare cases, been known to present itself almost in an acute form, having assumed a well marked character apparently within a very few months, or even weeks. But this is, indeed, very unusual. When it is moderate in degree, and uncombined with serious mechanical obstruction to the course of the blood, or other severe complications, it may run a course of many years, provided the manner of life be temperate, and that every thing which might unduly excite the heart's action be carefully avoided. From a slight degree of the disease, and under the above conditions, even little inconvenience, beyond a slight shortness of breath, or occasional inconsiderable palpitation, may for years be experienced; nor is it even incompatible with the attainment of a very advanced age. In children a preponderance of the size and action of the heart is indicated by strength of impulse; and loudness of its sound seems to be a very frequent, or even the natural condition, and continues in some degree up to the period of puberty, when the general development of the body establishes the due balance between the organ and the parts which it supplies.

As there is often much strength of body and particularly good powers of digestion in the incipient stages of this affection, the temptations to excess in exercise and diet are unfortunately strong, and too often lead not only to the rapid exacerbation of the disease of the heart, but also to the earlier supervention of apoplectic symptoms.

The formidable nature of the local disease, and the inefficiency of treatment, generally augment in proportion as dilatation tends to prevail over hypertrophy; and finally, the *prognosis* is still farther and in a fearful degree aggravated by the existence of the various complications already so often spoken of,—viz., valvular disease, pericardial and pulmonary inflammation, aneurism of the great vessels. &c.

Treatment. From what has been said of the nature of this affection, and of the circumstances by which it is exasperated, it is obvious that the chief indications of treatment consist in repose of mind and body, or rather in the restraint of their exercise within very moderate limits, together with extreme temperance in food and drinks, pushed in aggravated cases, provided the period of life gives any ground for expecting to effect a radical cure, even to the length of abstinence, and aided by a systematic and persevering employment of sanguineous depletion and other evacuant remedies. It is in this form of heart-disease alone,—viz., where hypertrophy is either simple or decidedly predominant, that the intensely lowering method of Albertini and Valsalva could be applied with any rational hopes of permanent benefit; nor is it often that even here it would be justifiable. Where dilatation and debility of the organ form the leading features of the disorder, the mistaken employment of such a proceeding could only tend to exasperate the morbid condition, and accelerate the fatal termination. Hence the vital im-

* Hope, p. 250.

portance of a correct diagnosis is evident. Few practitioners of the present day would venture to propose, and still fewer patients would be found willing to submit to, the treatment advocated by the celebrated Italian physicians just named, in its extreme or most rigorous form, consisting of constant confinement to bed, reiterated venesection, and a diet so low as barely to prolong existence. Laennec, however, has given his voice very warmly in favour of a modified employment of it, especially if early had recourse to. He commenced by taking away blood to a quantity just short of inducing fainting; and at brief intervals, as twice or thrice a-week, for example, repeating the operation till the palpitation and the vehement impulse of the heart had been got under; and at the same time reducing the quantity of food to half that usually consumed, or even much lower, until the patient's strength was brought so low as to leave him only able to crawl about for a few minutes at a time: and this plan must be persevered in steadily for at least eight weeks after all the symptoms of the disease have entirely vanished; and even then be only gradually relinquished, and instantly recurred to as often as these threaten to reappear; so that its whole duration may occupy many months or even a year or years. Nor does he think it inapplicable even to the more advanced stage of the disease, where dropsical symptoms and general cachexy have supervened; and he believes that it gives an additional chance to the efficacy of the necessary diuretic or hydragogue remedies. Dr. Mackintosh, who countenances the same kind of treatment, and speaks of confining the patient to a couple of biscuits in the day, recommends, where there is difficulty in restraining his appetite, the exhibition of small nauseating doses of tartar-emetic variously disguised. Drs. Hope and Forbes are less sanguine as to the efficacy of this heroic mode of treatment, having observed that these large and frequently repeated abstractions of blood, though they may for a time slightly alleviate the patient's sufferings, generally lead eventually, and especially when employed in the advanced stage of the affection, only to augmented debility and increased frequency of the paroxysms of palpitations and dyspnœa, and to consequent shortening of life. The effect of large venesections in producing prejudicial reaction in the first instance, and attenuation of the blood subsequently, is well known. Dr Hope, accordingly, in such cases, rarely takes away more than from six to eight ounces of blood, at intervals of two or three weeks, or even longer, so as just in some degree to keep down the heart's action, and to relieve dyspnœa; removing blood by cupping from the nape of the neck, if the head be much affected: the diet is to be moderate,—only the white kinds of animal food being permitted, and the use of liquids being restricted to small quantities, whilst stimulants of all kinds are of course strictly interdicted. Much benefit is often derived from the occasional application of a few leeches to the region of the heart: this mode of local bleeding may be had recourse to as an auxiliary to venesection; or it may be employed alone, when the powers of the patient render general bleeding not advisable. In regard to exercise, it should never be taken in such a manner as to hurry the circulation. Where blood-letting seems inexpedient, the daily use of saline aperients for a week or so at a time is a good substitute, or the exhibition of mild diuretics, as the super-tartrate or acetate of potash, or the decoction of broom; and, this even before dropsical symptoms have appeared. Subsequently, a selection of the most powerful of the same class of remedies, or, if they have failed, and the dropsical symptoms are on the advance, hydragogue purgatives must be had recourse to.

From the known influence of the stomach, intestines, and liver, on the action of the heart, Dr. Forbes insists, with great justice, on the essential importance of close attention to the condition of these organs in this and other cardiac diseases.

Where there is much irritability of the nervous system, considerable benefit often results from the judicious employment of narcotics (*Williams, Lombard, &c.*) as the extracts of hyoscyamus, conium, or belladonna, or the salts of morphia in fractional doses, or, though more rarely, from one to two drops of hydro-

cyanic acid. In the use of opiates, however, we must be cautious, as they produce great general derangement of system in some individuals,—locking up the secretions, and disordering the functions of the stomach and brain, and so eventually aggravating the deranged action of the heart. Camphor, assafœtida, and ether may occasionally be had recourse to with advantage, especially during the paroxysms of dyspnœa and palpitation.

About the efficacy of digitalis in quieting the action of the heart in these cases, there is considerable variety of opinion. Laennec had little or no confidence in it; whilst Bouillaud, on the other hand, styles it emphatically “the true opiate of the heart.” The last-named writer prefers the endermic method of exhibiting it,—a blister being applied on the skin of the præcordial region, and the raw surface sprinkled daily with from fifteen to sixteen grains of this substance in powder. Dr. Hope recommends the tincture internally, in doses of from twenty to thirty minims twice or thrice a-day; Dr. Davis is also partial to its employment. The co-existing state of other functions seems to have a great influence in determining the effect of this remedy; when the stomach or bowels are in an irritable or sub-inflammatory state, it is generally inapplicable. Of the danger of its accumulating in the system, and producing alarming depression and slowness of the heart’s action, as well as of deranging temporarily the cerebral functions, and thus giving rise to a remarkable form of delirium, every one who ventures on its employment should be well aware, and always on their guard, and ready instantly to intermit its use and counteract its ill effects.

The hydro-sulphuret of ammonia, in doses of four or five drops gradually increased to twenty or thirty, and largely diluted with water, was recommended some years ago by Dr. Marsh and Mr. Newton as a means of lowering the action of the heart without inducing much debility; but on the subsequent employment of it on a larger scale, in hospital practice, it does not appear to have sustained its character. (*Dub. Journal of Med. Sc.*, May, 1832; also a paper in same, by Dr. Thwaites, for Nov. 1832, vol. ii., p. 185; and another by Dr. Graves, in same volume, p. 23.) In excessive doses, or insufficiently diluted, it causes headach, nausea, and giddiness; and its use requires much circumspection.

The preparations of iodine, from their known power of promoting absorption, more especially of the solids, and controlling some of the chronic consequences of rheumatism, have been recommended in this affection; and very recently, the long continued and frequent employment of mercury in small doses has met with a strong advocate in Mr. Salter; and Dr. Colles, likewise, has dwelt with much and just emphasis on the beneficial influence of this remedy over some of the most distressing effects of morbus cordis.

When the symptoms have once been reduced by some of the various measures just spoken of, the establishment of permanent counter-irritation, by means of an issue or seton, either in the region of the heart, or, what sometimes answers better, at some distance from the affected organ, as in the arm, for example, is advisable. When the disease dates its commencement from the suppression of a chronic cutaneous complaint, or from repelled gout, and when we cannot recall these affections, recourse to counter-irritation in some of its forms is peculiarly indicated. Colchicum, moreover, is a useful auxiliary.

During the paroxysm of palpitation and difficulty of breathing, Morgagni was accustomed to employ, as a palliative, warm pediluvia, and at the same time to have the arms plunged into water as hot as could conveniently be borne,—measures which seem to owe any slight beneficial influence exerted by them, to their drawing away an additional quantity of the circulating fluid to the extremities, and so temporarily relieving the heart; and with the same view, dry cupping over the chest and back may be employed. But when there is much congestion of the lungs, severe dyspnœa, troublesome cough, or evidence of thoracic inflammation in some of its grades and varieties, the scarificators or leeches should be applied, or a moderate venesection speedily practised. In advanced cases,

however, and when the constitution is greatly enfeebled, the recurrence to general blood-letting demands much caution and discrimination.

Even in its earlier, uncomplicated, and most curable condition, hypertrophy of the heart requires for its permanent removal that the treatment should be steadily pursued, and for a very considerable period, which may be stated on an average at about one or two years. A slight intermission of the symptoms soon after the treatment has been commenced, affords no warrant for its interruption, but rather an inducement to proceed in the same path.

In all cases the patient, if he would avoid the speedy recurrence or aggravation of the complaint, must make up his mind for a life of temperance and self-control, both moral and physical. All over-loading of the stomach, whether with solids or fluids, however simple their nature, is to be studiously avoided, and a rather low scale of diet habitually adhered to. The age and habit of body, and the previous mode of living, must, however, be taken into consideration; for an extreme system of abstinence will, in many cases, by deranging the digestive functions, and unduly augmenting the nervous sensibility, give rise to a state of body very unfavourable to the regular and moderate action of the heart. Though violent or prolonged exercises are obviously improper, the opposite condition of total indolence and inactivity is scarcely less to be shunned, except at very aggravated periods of the disease; the object to be kept in view, being, on the one hand, to avoid all undue excitement of the nervous, vascular, and muscular systems; and, on the other, to support an equable distribution of power throughout the several functions, a healthy action of the capillaries, and a free state of all the secretions and excretions, and so to guard against the dangers of plethora and of local accumulation.

For some time past, I have completely given up the large and frequent blood-letting in hypertrophy of the heart. The inconvenience of this practice greatly exceeds its advantages. Hygienic measures, local blood-letting, the occasional use of digitalis, are the best and safest remedies.

G.

DILATATION OF THE HEART.

Nature and mode of production.—Anatomical characters.—Physical signs.—General symptoms.—Diagnosis.—Treatment.

Of the influences under which dilatation of the heart takes place, we have already spoken in the commencement of the preceding section, and also in our "General Observations on Diseases of the Heart," p. 484. It was there seen that they are reducible to obstruction in the course of the circulation, and weakness of fibre in the heart, often occurring simultaneously, though the latter alone seems adequate to the effect. When the power of the heart is not proportioned to the mass of the blood to which it should give motion, nor to the extent of the circulation, there is necessarily a tendency to accumulation and distention. It is in those who are advanced in life, and of a tall, slight make, and relaxed habit of body, that it is most apt to originate. On dissection, the muscular tissue of the part is very generally found to be unnatural in consistence and colour, being flabbier and easier torn than usual, and commonly of either an unnaturally pale or dark hue. It was conjectured by Burns, that the attenuation of the parietes might eventually be carried so far as to cause them to give way at some point; and Dr. Hope has since actually met with such a case, the patient having expired suddenly at stool, a fissure of an inch in length being discovered in the

left ventricle, which was softened, and of a violet colour around the aperture; and he alludes to a somewhat similar case, on the authority of Dr. Williams.

Of the local conditions said to predispose to dilatation, one of the most probable is weakness of one or more of the compartments of the heart of congenital origin; or a similar state induced under the influence of disease, as of inflammation of the organ, for example, and especially of its internal or external linings; for to the state of over-action in a muscle, induced in the first instance by the inflammation of a membrane in contact with it, one of atony is very apt, as Abercrombie has remarked, eventually to succeed.

Various general debilitating causes, as protracted fever, scurvy, and perhaps also scrofula (*Dr. Cheyne*,) chlorosis, excessive losses of blood, or the relaxed state of the solids brought on in some habits by the long-continued use of mercury,—or, in fine, impairment of the nutritive and stimulant qualities of the blood, however arising,—may be placed amongst the predisponents to this affection.

Chronic obstructions in the lungs, habitual paroxysms of dyspnœa or of nervous palpitation, sexual excesses, or any efforts which demand a frequent and protracted suspension of the respiration, or which at the same time accelerate the afflux of blood to the heart, and diminish its powers of reaction—violent as well as depressing passions, constant compression or deformity of the thoracic parietes, and trades in the exercise of which the trunk is ordinarily kept much bent, and the circulation on the descending and abdominal aorta interfered with,—all obviously have a tendency to aid in the development of the disease; as must likewise, and in a still more powerful manner, aneurism or other obstruction of the aorta, obstacles seated in the orifice of the heart itself, and lesions admitting of regurgitation.

Obstruction in an orifice or imperfection in a valve commonly manifest their influence first in the cavity immediately behind such causes. Eventually, however, the whole organ may become dilated; and not very seldom a more distant cavity, apparently from being peculiarly weak and yielding, suffers earlier than that in closest proximity to the obstacle.

Above all other causes, the most influential, according to Laennec, is congenital debility or disproportion in the organ itself. Few individuals, he believed, will be found to have a perfectly proportioned heart, if we compare the cavities amongst themselves, or estimate the power and capacity of the organ in relation to the other parts, as the lungs, the vascular system, inclusive of the capillaries, &c. From such disproportion, if the habits be temperate and the mode of existence favourable, no marked inconvenience may result during the greater part of life; but, on the other hand, the sudden supervention of emaciation, or irregular habits, violent exertions, or, on the contrary, too sedentary a life, may destroy the balance of the circulation, and lead to the development of the morbid tendency.

Anatomical characters. Dilatation may exist either with an increased, a natural, or a diminished thickness of the walls of the heart. The former two conditions have already been alluded to, when speaking of hypertrophy of the organ. Where, however, the enlargement of the cavities predominates greatly over the increase of substance in the parietes, the symptoms of debility and obstruction preponderate, and require, even from practical considerations, that such cases should be arranged under the head of dilatation rather than that of hypertrophy. Dilatation with attenuation is, however, a much rarer affection than that with an opposite condition of the parietes. In dilatation of the simple or passive kind, the parietes of the left ventricle are sometimes rendered as thin as those of the right in its natural condition; whilst the latter may be so attenuated as not to exceed the auricles in thickness. The simultaneous dilatation of both these cavities is much more common than that of only one. The columnæ carneæ are necessarily elongated, and participate in the general wasting of the organ. The septum ordinarily suffers least. Dilatation does not always affect the whole extent of a cavity; thus it is occasionally almost confined to the upper portion of the ventricle,

or near to where the great artery takes its rise; and in other instances it is more conspicuous in the lower part or the neighbourhood of the apex.

The auricles, from the less resisting nature of their parietes, are, according to Bouillaud, more prone to dilatation than the ventricles;* and the right ventricle, from the same cause, is more exposed to this change than the left. The right cavities have an additional source of dilatation in the frequent obstructions which occur to the pulmonary circulation.

Dilatation and hypertrophy of the auricles almost always present themselves combined.

In attempting to decide upon the existence of dilatation of the auricles, it is to be remembered, that though these cavities, in their natural state, are of nearly the same capacity with the ventricles, yet the external magnitude of the former, in consequence of the thinness of their walls, should not be more than half that of the latter. Another circumstance to be kept in mind, if we would avoid error, is, that the auricles, and especially the right, are liable to a considerable degree of temporary distention from the accumulation of blood in them taking place just before death, especially when of a lingering kind. This must be carefully discriminated from the structural change constituting permanent dilatation. As in the latter case, a certain degree of hypertrophy ordinarily co-exists, their parietes are more opaque, and, as remarked by Laennec, they do not shrink in the same manner on removing the contained blood, as when they are simply and recently distended.

Disease of the mitral valve often gives rise, not only to dilatation of the left auricle, but also, from its influence being reflected through the circuit of the pulmonary circulation, to that of the right ventricle and auricle.

Præternatural enlargement of the orifices of communication is very commonly associated with dilatation of the adjacent cavities; and where the growth or distention of the valves does not keep pace with such enlargement, or where the valves, from extreme attenuation, become perforated or lace-like, regurgitation is the result, and must necessarily tend to accelerate the progress of the disorder.

Physical signs. On applying the hand over the præcordial region, in the case of a greatly dilated and attenuated and feebly acting heart, a quick but very slight impulse is felt somewhat lower down, and more to the left side than natural. Even during the existence of palpitations, which are often peculiarly obstinate in these cases, the shock of the heart is still very feeble. If there be considerable difficulty in recognising it at all in the recumbent or erect posture, as is sometimes the case, by making the patient lean forward or lie on his face it becomes much more perceptible. The extent of dulness on percussion is manifestly augmented (especially in the directions just indicated in respect to the impulse,) provided emphysema of the lung do not interfere. Recourse being had to auscultation, the first sound is found to be of a peculiarly loud, clear, and brief character, approximating much in quality to the second sound, and being heard over a greater extent of the chest than natural; whilst the interval of silence is relatively augmented, in consequence of the shortness of the first sound. When the action of the heart is distinctly heard in the dorsal region, and the first sound is quite as clear as the second, the dilatation, according to Laennec, must be very considerable. When it is most loud under the cartilages of the left lower true ribs, the left side is chiefly affected; when under the inferior portion of the sternum, the right is principally implicated. Of the circumstances which limit the value of these

* This opinion is not, however, universally adopted. Dr. Williams's experience leads him to think that the right ventricle and the left auricle are the most common seats of simple dilatation; whilst Dr. Hope believes with Laennec, that the auricles, from being protected by their valves from the direct influence of the numerous causes of pressure which operate on the ventricles, are far more exempt both from dilatation and hypertrophy,—at least, as long as the valves are perfect. But where disease of the auricular valves arises, causing impediment or regurgitation, it speedily leads to their dilatation.—AUTHOR.

deductions, especially that which regards the extent over which the sound is audible, we have already spoken at large in the introductory remarks, p. 463. Dr. Hope, we may add, trusts much more to the quality of the sound, especially its shortness and clearness, than to its loudness; for he thinks that it is often louder in dilatation with hypertrophy, or even with a natural thickness of the parietes, than with attenuation; which last, when extreme, must tend greatly to weaken the energy of contraction; and this is in conformity with the observation of M. Bouillaud, though opposed to the more commonly received opinion originally promulgated by Laennec. The sound often loses its intensity for several days previous to death; and this is especially the case, when there is considerable softening of the muscular tissue, or an obstructed state of the lung.

General symptoms. The pulse is large, soft and compressible, and slow of reaching the distant arteries, but not essentially prone to irregularity or intermission when the dilatation is uncomplicated with softening of the heart, narrowing of the cardiac orifices, or valvular disease. In the latter stages of the affection, however, when excessive debility has supervened, as well as during severe attacks of dyspnœa, the pulse often becomes both irregular and small. The lungs are early and much oppressed, their vessels being over-distended with blood, and the pulmonary tissue infiltrated,—circumstances which explain the distressing tendency to dyspnœa, hæmoptysis, and habitual cough, with abundant watery expectoration. The capillary circulation is languid, the extremities consequently inclined to be cold; there is ordinarily little physical activity, and often a constitutional tendency to depression of spirits.

The necessary result of the accumulation of blood within the heart and lungs in these cases, is impediment to the venous circulation all over the body. Hence the early supervention of serous effusion, first in the extremities, and subsequently in the thoracic and abdominal cavities; the purple tint of the face, if the capillary vessels there be naturally much developed, or otherwise a pallid or leaden hue; congestion of the cerebral vessels, evinced by dull pain of the head; frequent recurrence of frightful dreams, and sudden starting from sleep in alarm; great want of mental energy, and for some time before death a marked tendency to stupor or coma—symptoms which appear to be connected in some instances with serous effusion within the cranium, and in others with extreme vascular distention. The mucous membranes are universally congested, and passive hæmorrhages from them, consequently, are frequent in the form of epistaxis, melæna, or bleeding from the intestines, &c. The viscera generally are enlarged and gorged with blood, more especially the liver; and the obstructed state of the portal system necessarily helps to accelerate the supervention of ascites. The general symptoms of dilatation of the right ventricle are scarcely to be distinguished from those of impediment to the circulation from other causes, and may be stated generally to consist in extreme dyspnœa, with a very early appearance of venous congestion, hæmoptyses, pulmonary infiltration, and universal dropsy. According to Laennec, an habitually swollen state of the external jugular veins, without pulsation, and not ceasing on the compression of the vessel in the upper part of its course, is one of the most frequent indications of this affection, and next in value to those furnished by the stethoscope.

Of dilatation of the auricles, as already stated, no characteristic signs are yet known; but the existence of such a condition may be looked upon as almost certain, when considerable obstruction or regurgitation is recognised in the adjacent orifices, or great enlargement of the ventricles has been detected together with a remarkable increase of dulness on percussion about the base of the heart. Most of the general symptoms usually ascribed to dilatation, as, for instance, the overloaded state of the capillaries, serous effusions, and passive hæmorrhages, are by Bertin referred directly and solely to some mechanical obstacle to the circulation, the common cause, according to him, both of the symptoms in question and of such enlargement. But this is too narrow a view, according to Dr. Hope, who very justly remarks that debility of the heart is in itself a sufficient cause of accumula-

tion of blood and consequent obstruction, and of the whole train of morbid effects just alluded to. Mechanical obstacles seated in a valve did not appear to Laennec, unless very considerable, necessarily to derange the circulation in any material degree, prior to the occurrence of enlargement of the heart. This latter state alone, on the contrary, and in the absence of all impediment at the orifices or in the great vessels, is quite adequate to produce great embarrassment, the distended and weakened muscular fibres being incompetent to deliver the organ duly of its contents, or to make way for the returning blood.

The *prognosis* in dilatation of the heart, when simple and moderate in degree, is much less formidable than where there is hypertrophy. It may often, by a tranquil mode of life, the prompt and appropriate treatment of any febrile or inflammatory disorders by which the patient may be casually attacked and which tend so injuriously to excite and derange the circulation, be prevented for many years from increasing, or causing any considerable inconvenience beyond the weakness of habit and tendency to dyspnoea on exertion which accompany it. When, however, dropsical effusions make their appearance, and in spite of regimen and medical treatment recur at short intervals, the fatal termination of the case, at no very distant date, is to be apprehended. The rapidity of its progress and the severity of the symptoms will, however, depend in a great degree on co-existing lesions, and more especially on disease, or inadequacy of the valves, obstruction of the orifices, and a chronic morbid condition of the bronchial membrane.

Treatment. When dilatation exists alone, or decidedly predominates over hypertrophy, and the action of the heart is consequently greatly weakened, a plan of treatment, in many respects the very opposite of that noticed in the last section, is obviously demanded. The object in the present case is, if possible, to improve the nutritive process in the heart, to augment the energy of its contractions, and so enable it more effectually to cope with the obstacles under the influence of which it is suffering. To fulfil these indications we are unfortunately in possession of no very direct means, and are obliged to trust to the influence of such agencies, therapeutic and dietetic, as tend gradually to improve the general health.

Where the tendency to dilatation can be traced to any obstruction of inflammatory or other origin in the heart or lungs, or in the course of the general circulation, the necessity of obviating its effects, or if possible entirely getting rid of it, is apparent. Inflammatory affections, especially of the organs contained within the chest, are to be promptly combated, and the absorption of effusions, whether of air or liquid, into the tissue of the lungs, or into the thoracic cavity, studiously promoted; the indulgence of all violent as well as depressing passions, and of every species of intemperance, restrained; unsuitable exertions of the respiratory organs and body generally, constrained postures and too sedentary habits avoided.

Where permanent obstruction in one or more of the orifices of the heart is in fault, or a congenital or deeply-rooted and long-established debility of the organ exists, it only remains for us in general to palliate existing symptoms, and to prevent, if possible, the supervention of new ones, especially of an inflammatory nature. Thus every precaution should be taken to avoid, or appropriate means exerted speedily to subdue catarrhal affections, as they tend so materially to aggravate the dyspnoea and to favour the development of the morbid condition of which we are treating. The body should be warmly clothed, and the cutaneous circulation strengthened by the use of the tepid shower-bath, diligent friction of the surface, and easy exercise. The diet should be nutritious without being stimulating, and the quantity taken at any one time ought to be very moderate, and liquids in particular sparingly indulged in, lest distention of the stomach and flatulence ensue, or relaxation of the muscular tissue generally, and that of the heart in particular, together with vascular repletion, be induced or augmented. Gentle but regular exercise, either walking, riding, or driving, according to previous habits and present strength, should be enjoined. The system should be braced by the

occasional use of tonics, more especially some of the preparations of iron, and all dyspeptic ailments immediately attended to.

In the choice of a residence, the dryness and purity of the air and freedom from the necessity of perpetually ascending flights of stairs within doors, and hills without, should chiefly be considered. In the more advanced stage of the affection, when pulmonary congestion and copious expectoration set in, a warm and humid atmosphere, as is judiciously remarked by Dr. Hope, is often more suitable, inasmuch as it favours both the cutaneous and the bronchial secretion. Where the susceptibility to cold is very marked, and the period of life advanced, it may be advisable during the colder months in this variable climate to confine the patient to the house, his apartments being well ventilated, but kept at the same time of an equable and rather elevated temperature.

During the paroxysms of dyspnœa, the occasional exhibition of an antispasmodic draught, and the free admission of fresh air to the lungs, whilst the surface of the body is protected by warm coverings, perspiration promoted, and the extremities plunged into warm water rendered somewhat stimulant by the addition of mustard, are amongst our chief resources. Opiates, though not altogether to be rejected, require caution in their use, as by checking the secretion or expectoration of mucus, they may often do more harm than good. Tea or coffee taken very hot, by their action on the nerves, and exhalants, sometimes afford considerable relief when the attacks assume the form of spasmodic asthma. Blood-letting to any extent is, generally speaking, inapplicable to this form of heart disease, and should scarcely ever be had recourse to, save with a view to cutting short the intercurrent inflammatory attacks, which occasionally complicate it; and even here the local abstraction of blood is generally preferable: and along with the use of calomel and Dover's powder, or antimony and aperients, together with blisters and other counter-irritants, is commonly quite sufficient to this end.

In extreme cases of dyspnœa, however, when all other means have failed, the removal of a few ounces of blood in the remissions of the paroxysm may sometimes be warrantable; but it is always a perilous remedy, too often only increasing the general debility, and rapidly accelerating the progress of the case. It has even been known, when carried to any considerable length, to produce an almost immediately fatal result, the enfeebled organ being paralyzed by the sudden reduction of its ordinary stimulus. For the treatment of *Dropsy* connected with disease of the heart, see *CARDIAC DROPSY*.

PARTIAL DILATATION, OR REAL ANEURISM, OF THE HEART.

Aneurism peculiar to the left side of the heart.—Aneurism of the left ventricle, its causes, symptoms, physical diagnosis, prognosis, and treatment.—Aneurism of the left auricle.—Aneurism of the valves.

DILATATION of the Heart is, in some rare instances, partial, being confined to one spot, which, being particularly yielding, gives rise to an aneurismal sac. Such aneurism may originate, as we have seen, in ulceration or in rupture of the interior of the heart, and the subsequent gradual distention of the muscular substance which forms the bottom of such ulcer or laceration. That it has not however always this source, but results occasionally from actual dilatation of all the coats of the organ, is deducible from the circumstance of its being sometimes possible

to trace, in the earlier stage, the lining membrane of the heart in an unbroken form into the interior of these pouches. In some instances, again, the disease seems to begin by dilatation, and to end in rupture of the endocardium and inner muscular fibres: and here the case in its commencement will fall under the denomination of true aneurism; and at another part of its progress, of that of false consecutive aneurism of the heart.

So many as three or four of these pouches have, in at least one instance, been found in the sides of the ventricle. Hitherto it has been invariably in the walls of the *left* cavities, and most commonly of the left ventricle, that this disease has been met with. Aneurism in the heart, then, as in the vessels, would seem to be confined to that portion of the circulatory apparatus which transmits the arterial or red blood. The exemption of the right ventricle is ascribed by Mr. Thurnam, in a recent elaborate monograph on the affection which we are now considering, to the yielding or imperfect nature of the tricuspid valve already alluded to, which necessarily tends to diminish the stress on the walls of this cavity. M. Breschet and M. Cruveilhier, it is farther remarked, were in error in ascribing such exemption to the greater relative thickness of its apex as compared with that of the left ventricle; for the vicinity of the apex, as has now been fully ascertained from the examination of a larger number of cases, is by no means the only portion of the ventricle liable to partial dilatation. It is true it still appears to be somewhat more frequently its seat than other parts of the cavity, but it also occurs, and not a great deal seldomer, near the base of the heart, and in some rare instances, likewise, in the middle or thickest portion of the walls, and even in the septum and valves.

The aneurismal sac is found sometimes imbedded in the substance of the *ventricle*, and sometimes prominent on its exterior wall, and is met with of various sizes, from that of a nut up to that of an orange, and in extreme cases even equaling the heart itself. In old cases in which it has attained to a considerable magnitude, the mouth of the sac is generally narrower than the rest of it, and often opens into the ventricle by projecting lips, and has its interior filled in a great degree with laminated coagula. In a few instances steatomatous or cartilaginous degeneration has been noticed in its walls; and most commonly strong adhesions exist between its outer surface, even though as yet but very slightly prominent, and the bag of the pericardium, the result of a process of nature which has the effect of strengthening the parts and preventing early hæmorrhage. The heart is very rarely free from other concomitant disease. The co-existing morbid alterations are, as Mr. Thurnam remarks, generally of an inflammatory origin, such as opacity and roughness of the endocardium, ossification of the valves, &c. Either dilatation or hypertrophy of the heart, or at least of the left ventricle, existed in above a third of all the cases, fifty-eight in number, which have been collected and carefully analyzed by him. The frequency of the affection in males, as compared with females, is as three to one,—a disproportion which, though considerable, is far inferior to that known to obtain in respect to aneurism of the arteries; the latter, moreover, has been ascertained to be chiefly confined to the period of life comprised between the thirtieth and fiftieth year; whilst the analogous affection of the heart does not manifest a decided preference for any particular age from puberty upwards.

Of its *causes* nothing very precise can be stated, save that, like as in regard to many other diseases of the heart, fatiguing exercises, intemperance, vehement passions and rheumatism, have appeared in some instances to predispose to it; and that its first symptoms in a few cases have coincided with the reception of a severe blow on the chest, a bad fall, or violent mental emotion. In the great majority of cases Mr. Thurnam, contrary to most other observers, believes it to be of the nature of true aneurism, commencing by a gradual dilatation of all the tissues in consequence of a local weakness in the wall of the heart, probably for the most part of an inflammatory origin. He supposes farther that it may have its source

in the gradual distention of some one of the sulci or pits which exist in the natural state in such number amongst the adherent and variously crossing columnæ carneæ, through the agency of a coagulum spontaneously forming within it and enlarging it.

A variety of this affection, involving the whole circumference of the ventricle in a part of its length, is noticed under the title of *Diffused True Aneurism*, analogous to the cylindrical or fusiform aneurism of the arteries. A remarkable case of this kind has been met with by Dr. Macreight, in which the apex and adjacent portion of the heart were distended into a bag capable of containing a small orange, the walls of which were of a cellulo-fibrous texture, and ossified in parts, whilst the base of the organ was in a state of hypertrophy: ossification of the aorta and its valves was likewise present.

Another species, originally observed by Dr. Hope, is spoken of under the name of "dissecting aneurism of the heart," in which the blood burrows under the internal lining membrane, and makes its way out again into the cavity at some distance.

Instances of "hernial aneurism" have likewise been met with in the heart, where the internal coat, itself intact, protrudes through a hole in the middle or muscular tissue, the sac being then formed jointly by the endocardium and pericardium.

In aneurism of the septum opening quite through into the adjacent cavity, we have a parallel to varicose aneurism of the vessels. There being thus, continues Mr. Thurnam, for every species of arterial aneurism, an analogous variety discoverable amongst the partial dilatations of the heart (if we except "the external mixed aneurism," for the impossibility of the occurrence of which in this organ there exists an obvious anatomical cause,—the absence of an external cellular coat,) it is obvious how erroneous are the views of those who imagine an affinity to exist between general dilatation, or that affecting the interior of one or more of the cavities of the heart, and the aneurismal enlargement of an artery. Such general enlargement, by which the heart adapts its dimensions to co-existing circumstances in the circulation, is more allied to the physiological process by which the arteries become dilated, when there is an additional demand made on them, as in the case of the arteries supplying the gravid uterus, or a tumour, or the collateral branches, which re-establish the circulation where a main arterial trunk has been obstructed.

The *symptoms* of this affection are very obscure. Its commencement is for the most part insidious, and not marked by any distinct functional derangement. In the more advanced period, dyspnœa, præcordial pain, or rather a sense of weight and uneasiness, dropsy, palpitation, and tendency to syncope, and other symptoms indicative of a disease of the heart, are occasionally present; but from the very common co-existence of other lesions of this organ, it is impossible to say how much of all these functional derangements can be fairly laid to the charge of the affection in question.

The *physical diagnosis* is as yet no less dubious. Negative evidence, as Dr. Hope remarks, might occasionally at least excite a suspicion of the true nature of some of these lesions,—as, for example, the absence of the appropriate signs of valvular disease, and of any of the varieties of pulse characteristic of better known forms of cardiac disease. Dr. Williams apprehends that there may sometimes exist a bellows murmur or whizzing sound accompanying the systole, if the opening of communication be somewhat contracted, as also either a diminished, increased, or tumultuous action of the heart: if of unusually great size, there might possibly be a pulsating tumour felt opposite to the cartilages of the ribs, with increased extent of dulness on percussion, and perhaps some displacement of the organ. It might be practicable to distinguish it from aneurism of the descending aorta by the absence of any unusual pulsation or grating sound along the left side of the dorsal vertebræ. As to aneurism of the commencement of the

aorta, which as it enlarges presses upon and occasionally bursts into the heart, it seems improbable that we shall ever be able to discriminate it by any characteristic physical signs from the affection here spoken of.

Where the septum is perforated from the bursting of an aneurism seated in it, cyanosis might, by its sudden supervention, lead to a suspicion of the nature of the case.

The *prognosis* of this disease, supposing its existence to be recognised, is evidently of the gloomiest description. Its duration would seem to vary from a few days to several months or years. Death has occasionally taken place by syncope, but more generally by internal hæmorrhage into the pericardium. It has been known to end in apoplexy, and also sometimes, like other cardiac affections, by obstruction of the lungs, and the gradual supervention of asphyxia.

The *treatment* most applicable to this disease, if discoverable, would partake equally of that proper in aortic aneurism and of that of dilatation of the heart; the objects being to induce organization of the coagula, and obliteration of the sac, without at the same time too much sinking the powers of the organ. Hence a moderate use of the antiphlogistic system, together with the scrupulous avoidance of all stimuli, moral or physical, which could produce injurious excitement.

A single case only of *sacculated aneurism of the auricle* has been seen by Mr. Thurnam amongst all the pathological museums examined by him; and in this the pouch, about the size of a nut, was filled with coagula, and communicated with the cavity by a narrow neck. The aneurismal affection of the auricle is almost always of the *diffused* kind, involving the entire sinus or the appendix; the dilated walls being generally thickened and opaque, rough, and occasionally ossified, and the cavity occupied by fibrinous concretions. Narrowing of the mitral orifice exists in almost every instance.

Aneurism of the valves of the heart. The mitral valves have sometimes been observed to form an elongated pouch-like projection into the left auricle, of which an example has been recorded by Morand, another by Laennec, and a third by Mr. South. The aortic valves were found simultaneously extensively ossified, so that the development of the disease was probably intimately connected with impediment to the escape of the blood from the ventricle, and consequently greater reaction against the yielding, and, in most instances, diseased structure, of the dilated valve. A similar appearance has been met with in the aortic valves themselves, and even in the tricuspid. Coagula have not been observed in the pouches so formed; and for their absence the incessant agitation to which these parts are exposed, sufficiently accounts. Such aneurismal tumours must materially obstruct the passage of the blood by their bulk, and where the sac becomes eventually perforated by ulceration or rupture, regurgitation will necessarily take place. Their stethoscopic signs, we apprehend, will be merely those of obstruction or regurgitation.

ATROPHY OF THE HEART.

THE heart, like other muscles, is liable to a remarkable diminution in size, more especially in certain kinds of chronic disease, as the tubercular, cancerous, and gastro-enteritic cachexies, which are attended with much general exhaustion and emaciation. It may likewise be induced by excessive and long-continued depletions, the pressure of pericardial effusions, obstruction of the coronary arteries, and perhaps also by a long-continued state of mental depression. In regard

to this last, however, there will often be room for doubting whether it should be ranked as a cause, or as an effect.

In extreme cases the heart of an adult has been found to be no larger than that of a child, or even of an infant, having lost a third or half or more of its natural magnitude. For more precise information as to the extent to which such wasting may be carried, we must refer to what has been said in the introductory remarks. (See pp. 456-459.)

The cavities of the heart in these cases are often remarkably diminished in size, and the walls, in thus contracting on themselves, occasionally appear, notwithstanding their real loss of substance, even thicker than natural (but they are then commonly wrinkled on their surface,) or the opposite state may present itself, that of extreme attenuation of the parietes with dilatation. The muscular substance is, moreover, very generally altered also in colour and consistence from its natural state.

Of the difference of opinion existing amongst pathologists as to the occasional connexion of this condition of the heart with phthisis, we have already spoken, p. 457. Laennec, who seems to have considered it as a distinct well defined disease, remarks that it confers a certain degree of immunity from inflammatory affections, and is, on the other hand, often accompanied by hypochondriasis and a tendency to faint from very slight causes.

The general *symptoms* are those of depressed vital energy manifested throughout all the functions of the economy,—emaciation and proneness to dropsical effusion; whilst the physical signs consist in peculiar feebleness of the sounds and impulse; the latter being unusually circumscribed as to the extent in which it can be felt, and occasionally even altogether imperceptible, save in the prone position of the trunk: whilst at the same time the natural dulness on percussion in the præcordial region is either not at all perceptible, or is limited within unusually narrow bounds. The pulse is not only weak, but uncommonly small and thread-like.

As to the *treatment* of wasting of the heart, most of what has been already laid down in respect to the management of dilatation of the organ is equally applicable here.

CHANGES IN THE CONSISTENCE AND COLOUR OF THE HEART, MORBID EFFUSIONS INTO ITS SUBSTANCE, AND NEW FORMATIONS.

Induration.—Softening.—Œdema.—Hæmorrhagic effusion.—Purulent deposits.—Ossification of its vessels.—Surcharge of fat.—Tubercle, fungus hæmatodes, or encephaloid cancer.—Scirrhus.—Tumours.—Serous cysts.—Hydatids.—Cartilaginous and bony deposits.

INDURATION of the substance of the heart has already been alluded to in connexion with hypertrophy and with carditis; and it was stated that its density was sometimes so remarkably increased, that when struck it resounded like a leather dice-box, or the coriaceous hull of the cocoa-nut; and yet occasionally, even in these extreme cases, its colour has not deviated strikingly from that which is natural to it. Nor was its contractile power in these instances considered by Laennec, as it was by Corvisart, to be impaired, but, on the contrary, he thought it was even augmented,—an opinion which later observations by no means confirm,—nor yet did he coincide with Bertin and Bouillaud, in looking upon it as a preparatory step to ossification, such a transition never having been observed by

him. The one affection, moreover, he remarks, occupies very generally the whole heart, and has its chief seat apparently in the muscular fibre; whilst the other morbid process is commonly very partial, and manifests a decided preference for the serous, cellular, or fibrous portion of its structure.

Softening of the heart, with various alterations of its colour, has likewise been already treated of in the section on Carditis, inasmuch as it appears to be sometimes at least of inflammatory origin. The sounds of the heart in well marked cases are much impaired, and when this change exists in an extreme degree, the first sound may be almost or altogether inaudible, the impulse likewise being notably diminished, except during the presence of palpitations. The beat of the pulse is brief and feeble, and for the most part unequal and irregular, or intermittent. Softening of the heart appears to predispose in a remarkable degree to dilatation of its cavities, as well as greatly to aggravate the nature of this lesion: where the two alterations co-exist, the former tends in some degree to prevent the clearness and loudness of sound characteristic of the latter; and the disproportion between the extent of dulness on percussion, and the intensity of the natural sounds of the organ, may lead to a suspicion of the nature of the complication.

A softened condition of the heart is often met with on dissection in cases of hypertrophy with dilatation, where death has been preceded by long and frequent attacks of dyspnœa, and where the patient having survived for some weeks in a state of impending suffocation, a high degree of venous congestion has taken place in consequence of the obstructed state of the circulation.

The diagnosis between softening and disease of the mitral valve—affections in both of which the pulse is small and irregular—may be made, as Dr. Hope remarks, by the absence of the murmur characteristic of valvular disease. The two lesions often, however, it must be remembered, co-exist—and also that a very similar irregularity of the pulse may depend merely on temporary nervousness, violent dyspnœa, or excessive debility, as in the moribund state. When hypertrophy and softening co-exist, we may generally, according to the same authority, recognise the first by the impulse of the heart being either constantly, or with occasional beats, decidedly stronger than natural—and the latter alteration, by the first sound being not only diminished, as in simple hypertrophy, but having moreover a short flapping character approximating to that of the second sound, as if it were now almost entirely dependent on the sound of valvular extension.

The softened and somewhat glutinous state of the heart, observed in the advanced stage of putrid fevers, was supposed by Laennec to be but a part of the general affection of the muscular system in these cases, owing to a diminution of their solid, in proportion to their liquid constituents. Dr. Stokes, who has recently paid much attention to this subject, takes rather a different view of it, considering the softening of the heart to be a peculiar local secondary effect of typhus, and often to exist where the muscles of locomotion are little, if at all, altered from their natural colour and consistence (*Dub. Med. Journ.*, March, 1839.) Where it exists in a marked degree, the first sound of the heart becomes quite inaudible and the impulse deficient. From the great feebleness or absence of the systolic sound, he has satisfied himself that a valuable practical indication may be deduced in respect to the propriety of resorting to stimulants, and one which he holds to be much more trustworthy than the state of the pulse, which is not always, by any means, in accurate relation with it. Accordingly, where there is absence or extreme diminution of the first sound in typhoid fevers, he administers wine boldly, no matter what other secondary affections of the gastro-intestinal mucous membrane, pulmonary organs or brain, may co-exist, and believes that where the stimulant plan is, under such circumstances, neglected, and the strength not adequately supported until this and other concomitant secondary affections, as well as the fever itself, have run their course, syncope is very apt to occur and prove fatal. Where, on the contrary, wine and other stimulants having been diligently exhibited during a day or two, the pulse begins to lose its frequency, and the first

sound of the heart becomes again audible, the prognosis becomes decidedly favourable, and the propriety of the line of treatment adopted confirmed.

There remains still another species of softening of the heart to be adverted to,—viz., that where an unusual quantity of fat envelopes the organ, and is intermixed with its muscular fibres, its substance in such cases loses altogether its natural firmness, and becomes of a peculiarly light colour, and seems prone to rupture.

It is probable that many obscure cases of sudden and unexpected death have their origin in syncope connected with ramollissement of the heart. The treatment of softening of the heart when independent of inflammation, or where this, if its original cause, has been subdued, is similar to that of dilatation, a morbid condition with which, as we have seen, it very frequently co-exists.

An *adematous* state of the cellular membrane enveloping the heart, and connecting its fibres, has been noticed by M. Bouillaud both in connexion with a general dropsical condition of the system and also with a varicose appearance of the cardiac veins, indicative of the difficulty with which they discharge themselves into the right auricle in consequence generally of some concomitant obstruction within the heart. A similar dropsical state of the organ may also originate in obliteration of some of these same vessels.

The heart is occasionally the subject of *hæmorrhagic effusion*, either in the form of patches or petechiæ, on one or both of its surfaces, as has sometimes been observed both in land and sea-scurvy and in putrid fevers; or blood may be poured out in larger quantities, and either infiltrated into the very substance of the organ, or collected into a factitious cavity formed by the separation and laceration of its fibres, constituting the disease spoken of by some authors under the title of *apoplexy of the heart*. Cruveilhier, who has seen many instances of it, believes it to be much more often than inflammation and ulceration the cause of rupture of the heart. Hitherto it has only been observed in the left ventricle, and generally in connexion with hypertrophy.

The muscular fibres are found quite broken down and displaced, and a coagulum occupies the cavity so formed, and with it, at a later period, purulent matter appears to be mixed. Perforation towards the inner or outer surface of the organ seems to be a frequent result, as is likewise the false consecutive aneurism described by Breschet.

Purulent deposits within the parietes of the heart have already been alluded to in our account of carditis. When of inflammatory origin, the muscular substance surrounding them is generally in a softened condition. They have their source probably, in some instances, in the translation of pus in the blood from some distant organ in a state of suppuration.

The *vessels* which supply the heart are not exempt from disease. In addition to its varicose state of the veins just alluded to, *ossification* of the nutrient arteries is by no means very unfrequent in the aged: it is not, however, necessarily productive of the formidable consequences ascribed to it by Parry and some other authors, who have endeavoured to connect it inseparably, as already mentioned, with the group of intensely distressing symptoms described under the head of *ANGINA PECTORIS*. Enlargement of the arterial and venous coronaries is, as Bizot has pointed out, the ordinary consequence of advancing years; and this is only in conformity with what we should expect from knowing that the heart, which is dependent on them for support, gradually increases in size and weight as old age approaches. The derangement of the nerves which supply the organ has already been spoken of.

The heart is often found *overloaded with fat*, especially about its base, and along the course of the coronaries, in the furrow of separation between the adjacent cavities, and likewise occasionally on its flat surface. In such cases, there is often an excess of the same substance in the neighbouring mediastinum, especially in front of the pericardium. The muscular structure of the heart is ordi-

narily much reduced in thickness and firmness, where in contact with the accumulated fatty deposit, either in consequence of its pressure, or from the new appropriation of the nutritive fluid.

The heart in one or more of its cavities is in these cases frequently at the same time greatly enlarged. Though the adipose matter may occasionally penetrate for some way between the muscular fibres, yet the two structures do not here run insensibly into each other, but are, on the contrary, perfectly distinct, so as to be capable of being separated cleanly by the dissecting knife. Corvisart, Laennec, and Hope, all agree in considering this as a mere augmentation of a natural deposit, and unattended, as far as their experience reaches, with any definite morbid symptoms; still if in very great excess, it could scarcely fail, we apprehend, in some degree to enfeeble or embarrass the heart's action. M. Chomel believes that it may, in such extreme cases, give rise to dyspnoea, palpitations, and a sense of sinking, together with feebleness of pulse and dropsical tendency; and others, as we have already seen, ascribe to it, though on less plausible grounds, the production of all the symptoms of angina pectoris. Dr. Hope considers its signs to consist in "diminution of the sounds, especially the first; irregular pulse without valvular disease; and oppression or even pain in the præcordial region; with general signs of a retarded circulation, producing cerebral, hepatic, and other congestions."

It is much more common in females than in men, and is met with frequently where there is no tendency to obesity in other parts of the body. The habitual use of fermented liquors to excess seems in some constitutions to favour the morbid deposition of fat in this as well as in other situations.

But besides the condition above described, the heart is liable, like the Solæi and some other muscles, to a species of *true fatty degeneration*, in which a portion of the muscular tissue of the organ becomes actually transmuted into adipose matter. This change seems generally to commence towards the apex of the organ, and thence spreads upwards; and has appeared in some instances to be ushered in by inflammatory symptoms. Unlike the former species of fatty deposit, the transition here from the one to the other tissue is gradual and insensible. The affected parts are of a pale yellowish hue, softened and greasy to the touch. The external muscular layers suffer first; and from these it spreads gradually inwards till a mere shell of muscular substance has been left, consisting, in extreme cases, such as that recorded by Mr. Adams, of little more than the reticulated interior of the ventricle; and even those fibres which are but little altered in appearance will impart to paper a greasy stain, as Laennec has pointed out. The latter had never, within his own experience, known it to determine a rupture of the heart, and confessed himself unable to ascribe to it any characteristic symptoms. It seems obviously, however, from the cases recorded by Mr. Adams and Dr. Cheyne to predispose to serous effusions and to apoplexy, as the impediment to the circulation, necessarily connected with such a weakened state of the heart, would lead us to expect.

In two remarkable examples of greasy degeneration of the heart described by Mr. Smith of Dublin, globules of a limpid oily matter were found floating on the blood in such quantity that half an ounce of pure oil was with ease collected,—its presence affording, as Mr. Smith remarks, an additional evidence of imperfect assimilation. In one of these cases, too, rupture of the left ventricle had taken place. In similar cases the texture of the heart, which breaks down readily between the fingers, has been compared to liver by M. Bizot.

If this affection were recognisable during life, the appropriate *treatment* would consist in such measures, dietetic and medicinal, as are calculated to give additional activity to the processes of digestion and assimilation, to render the circulation less languid, and to cause the absorption of redundant adipose deposits;—such as suitable exercise in a bracing atmosphere, temperance in diet, due regulation of the functions of the stomach and intestines, together with the exhibition of such remedies as are known to increase the tone of the nervous, muscular, and vascular systems. The preparations of iodine, moreover, on account of their marked

influence over the absorbents, especially those of the cellular tissue, would seem here to be deserving of trial.

NEW FORMATIONS. The heart, as compared with most other organs, appear to enjoy a remarkable degree of exemption from the formation of ADVENTITIOUS GROWTHS, if the products of ossification only be excluded, together with the warty and cauliflower excrescences on the valves, the nature of which has been already discussed in connexion with the inflammation of the internal lining membrane.

The presence of *tubercle* in the muscular structure of the heart is rare, no instance of it being given either in Louis or Lombard's tables exemplifying the comparative frequency of the occurrence of tubercular matter in the different parts of the body, and comprising together above five hundred examples of the presence of this morbid product. Laennec, however, had met with it three or four times in this situation. M. Sauzier speaks of having detected it in the substance of the auricles of a strumous subject, and Dr. Hope, once, in that of the right ventricle of a child. Andral states that it is never found in the heart without existing simultaneously in several other organs; but neither he nor Bouillaud appear themselves to have seen it so situated.

Fungus hæmatodes, the *encephaloid cancer* of the French, is likewise very uncommon here, though it has been met with, both infiltrated and in the form of separate tumours, but almost exclusively in cases where it was extensively diffused through other organs at the same time.

An example of what appeared to be true *scirrhus* was met with by Recamier; and Rullier and Billard seem to have seen each another. A fourth instance in an advanced state of carcinomatous ulceration, occupying the whole posterior surface of the left ventricle, is quoted by Andral from the description by Carcassonne in the *Transactions of the Royal Society of Medicine* for the year 1776; which had been characterized by pungent pain, palpitations, small intermitting pulse, syncope, and orthopnoea.

In a few instances on record, cancerous disease implicating the heart has appeared to have had its origin in the anterior mediastinum, or in the fibrous layer of the pericardium. In a case of very marked cancerous diathesis,[§] in which even the bones were extensively affected, we have seen a minute tumour apparently of a scirrhus nature under the pericardium lining the heart.

Melicerouss, *teatomatous*, and *various encysted tumours* have also, though rarely, been discovered within the parietes of the heart. *Serous cysts*, varying in size from a pea to a hen's egg, have likewise been observed by Dupuytren and others in the same situation, but more commonly between the walls and the external serous membrane; and Andral once met with one, about as large as a small nut, attached to the internal lining of the right ventricle.

Hydatids have also been found in the substance of this organ: Morgagni mentions an instance of this kind, which appears from his description to have been an example of the genus *Cysticercus*; and Andral has recorded a similar one. They are, as observed by the last-named author, by no means rare in the heart of measles pigs.

The *symptoms* of these foreign growths are commonly very obscure. By their number, bulk, or interference with the freedom of the valves or orifices, they are obviously capable of occasionally producing both physical and general signs; but we are not yet in possession of definite knowledge of any symptoms which can be considered truly characteristic.

The encephaloid cancer or medullary sarcoma has sometimes been attended by fits of excruciating pain of a lancinating character, and by that peculiar sallow or straw-coloured complexion indicative of malignant disease; in addition to habitual dyspnoea, frequent palpitations, and finally dropsical symptoms.

Cartilaginous and bony deposites. Of morbid depositions of a cartilaginous or bony nature taking place in the valves, the tendinous zones of the orifices, or internal lining membrane of the heart (and especially in the left side of the or-

gan,) and also in its pericardial covering, or in the false membranes interposed between its two serous surfaces after violent attacks of inflammation, we have already given an account in the sections devoted to endocarditis and to pericarditis. But the muscular tissue itself is liable to a similar species of degeneration or encroachment, though such an occurrence here is infinitely more rare. Corvisart has detailed a case of hypertrophy of the left ventricle, where the heart at its point, and for some way upwards, was converted throughout its whole surface into cartilage, the columnæ carneæ likewise participating in the affection, and the mitral valve being diseased. The disease had obviously commenced by an inflammatory attack within the chest, about eighteen months before its fatal termination. The pulse was small and irregular, and quite disproportioned to the apparent energy of the heart's contraction. A similar case has more recently been met with by Mr. Smith of Dublin, in an epileptic lunatic of forty-five years of age, who died in a convulsion. "The cavity of the left ventricle of the heart was slightly enlarged, and its parietes diminished in thickness. The muscular substance had completely lost its natural colour and consistence, particularly towards the apex of the ventricle; it was converted into a dense, white, firm cartilaginous structure, the division of which with scissors required the employment of considerable force: the alteration of structure had extended to some of the carneæ columnæ, and the auricles were hypertrophied." The cerebral vessels were found distended with dark blood, the retardation of the circulation in them being probably, as Mr. Smith observes, a consequence of the impaired contractile power of the heart. M. Renaudin's singular case, in which the left ventricle was converted, as it were, into a petrification, the columnæ resembling stalactites within its cavity, has been already alluded to. In Burns' celebrated case of ossification of the heart, the pericardial sac which adhered to the ventricles, and the entire ventricles themselves, with the exception of about a cubic inch at the apex and part of the columnæ carneæ, were "ossified and firm as the skull." The patient, a woman of sixty, had never been known to complain either of palpitation or pain in the heart. Andral has seen an ossific tumour isolated in the middle of the muscular substance of the left ventricle. It is probable that, in all such cases, the deposite of phosphate of lime takes place into the intermuscular cellular tissue, and that the true muscular fibre in its proximity becomes atrophied and supplanted rather than absolutely transformed.

A bony girdle of varying width, its average breadth being about one inch, was found by Mr. Smith surrounding nearly the entire of the base of the heart, in a man of thirty-nine years of age who had laboured under all the ordinary symptoms of diseased heart. The external surface of the ossific deposite was quite rough; its inner portion penetrated into the muscular substance of the ventricles, coming almost in contact with their internal lining membrane. The auricles were remarkably hypertrophied, a great portion of the duty of the ventricles having devolved on them. The opposed surfaces of the pericardium were universally adherent, and the bony matter appeared to have been originally deposited in the adventitious membranes of inflammatory origin; and such is probably the true explanation of most of the superficial ossifications of the heart related by authors. Yet withal, ossification within the pericardial sac is much more rarely observed than in the case of most of the other serous membranes.

RUPTURE OF THE HEART.

Causes.—Frequency in respect of the different cavities of the heart.—Seats of this lesion.—

Symptoms and treatment.—Rupture of the valves of the heart.—Wounds of the heart, and their treatment.

RUPTURE of the Heart may be caused either by external violence, or by its own efforts; but, in the latter case, previous disease of the organ seems almost a necessary condition.

Amongst the external injuries capable of rupturing the heart may be enumerated falls from a considerable height, even though the person lights on his feet; heavy carriages passing over the chest; the kick of a horse, or other severe blow. By such violence, the ventricles, generally the right, as being the most exposed, the auricles, the valves, and septum, and the great vessels at their origin, have been known to be torn across or burst, even in cases when the parietes of the chest have escaped without any fracture or other obvious injury.

Of the morbid conditions which predispose to rupture, ulceration of the inner membrane, as already mentioned under the head of **ENDOCARDITIS**, is one, and, according to Laennec, by much the most usual one. We are not, on the other hand, aware of any well authenticated instance where it had its origin in ulceration commencing on the pericardial surface of the heart, though such an occurrence is obviously possible. Abscesses or tumours within the cardiac parietes discharging their contents through either or both surfaces of the organ, ramollissement, partial or general, also the condition described at a former page, under the name of **APOPLEXY OF THE HEART**, fatty degeneration, or the thinning and weakening of its muscular tissue from any other cause;—and, finally, partial aneurism of the organ itself, or the continued pressure of an aneurism of the aorta, or other thoracic tumour, may all of them conduce to the same formidable result; and most effectively in those cases where impediment in the orifices or hypertrophy co-exists.

The immediate determining cause of rupture may be either some external injury, or the momentarily augmented action of the organ itself; such as takes place from strong mental emotion, or during violent muscular exertions, as in struggling, coughing, vomiting, or straining at stool, &c. It has likewise been known to occur during an apoplectic attack, as also in the convulsions of an epileptic fit; and the Hun Attila's is not the only instance on record where the heart has given way in the act of coition. When, however, the predisposing conditions have already greatly weakened its walls, even the ordinary motions of the organ may suffice to rupture it.

This lesion, when occurring *spontaneously*, has been observed in a great majority of cases, in the left ventricle; the right ventricle comes next in point of frequency, then the right auricle, and lastly the left auricle. When, however, it results solely from great external violence, the proportionate frequency of its occurrence, to judge from M. Ollivier's investigations, is in favour of the right cavities as compared with the left, and of the auricles as compared with the ventricles,—a circumstance for which position and relative weakness of walls appear sufficiently to account.

It seems from Dr. Townsend's tables to be twice as frequent in men as in women, and very rarely to occur spontaneously before the sixtieth year. In some instances more than one rupture has been detected in a single cavity. In a remarkable case related by Andral there were found no less than five lacerations in

the back part of the left ventricle, unaccompanied by any obvious softening around their margins. As to the point where this lesion most commonly occurs, there is great discrepancy of opinion. Thus, according to the distinguished pathologist just named, the middle of the ventricle, notwithstanding its great comparative thickness, is the most frequent seat of rupture: and Laennec, too, remarks that it is rare towards the apex, though one of the thinnest parts. Dr. Townsend with some other writers who have attended much to the subject, stands opposed to these authorities, and asserts, on the apparently satisfactory grounds of numerical investigation, that the apex of the left ventricle, or rather a point half an inch above it, and at the same distance from the septum, is the most frequent situation of this lesion, having been observed in nineteen out of the twenty-five cases analyzed by him; and hence he thought we might deduce that Laennec was in error, in considering ulceration, which manifests no peculiar preference for this point, to be the chief source of rupture. Dr. Townsend thinks it is, on the other hand, most commonly the consequence of a form of hypertrophy described by M. Rostan as not uncommon in advanced life, in which, whilst an increase of thickness takes place towards the basis of the heart, the apex becomes thinner than natural, and a general softening of the parietes often co-exists.

The above evidence, in favour of the greater frequency of rupture near the point of the heart, though apparently so strong, is yet not altogether conclusive; for M. Ollivier from the examination of nearly double the above number of recorded cases of its spontaneous occurrence, in thirty-four of which it occupied the left ventricle, has ascertained that the apex was its seat only in nine; thus affording a fresh proof, that, to give solidity to deductions arrived at through the numerical method, a very extended basis of observation is indispensable: nor do we feel certain that the question is even yet settled.

In some rare instances the external fibres of the heart have alone been found lacerated, the fissure not extending into any of its cavities. When however the rupture is of some size, and penetrates quite through the parietes of the organ, death is for the most part its almost instantaneous result, in consequence of the sudden effusion of blood into the pericardium, the derangement of the functions of the heart by the pressure so caused, and the arrest of the cerebral circulation thence ensuing. Where the aperture however has been very small, and its track through the walls oblique, a coagulum has, in some very rare instances, been formed within it, and, with the aid of the great mass of coagulated blood in the pericardium pressing against the mouth of the wound, delayed the fatal event for a few hours, or even days. Theoretically speaking, even cicatrization is not impossible; and Rostan adduces a case in which this appeared to him to have actually occurred.

The immediate *symptoms* of rupture of the heart are, faintness, absence of pulse, sudden syncope with cold extremities, and collapsed features—a state of things very different indeed from that occurring in apoplexy with which the ignorant so often in the first instance confound these cases. In the effusion of blood within the head, death rarely, if ever, ensues so instantaneously.

In some instances of rupture of the heart, the fatal stroke has been preceded for some time by pain in the præcordium, extending occasionally to the left shoulder, with or without other symptoms of heart disease; whilst in others no premonitory ailments have existed.

Of the treatment of so suddenly fatal an affection it is almost unnecessary to speak. In the very unusual cases, however, where life is not instantaneously cut short, the obvious indications would be to support the nervous system in the first place under the shock which has been inflicted, and subsequently to keep down the action of the heart by absolute repose of mind and body, all even the slightest exertion of the voluntary muscles being scrupulously avoided; by complete abstinence from solid food, and making use even of liquids only in the smallest quantities, and by the employment of every means likely to promote the formation of a clot within the ruptured orifice, and to prevent its dislodgement.

The heart is subject, moreover, to another species of *partial* rupture, implicating its valves, their tendons or muscular columnæ, the occurrence of which commonly gives rise to sudden and extreme sense of suffocation, with excruciating pain, violent disturbance of its action, and indescribably tumultuous sounds within the chest. On applying the hand to the præcordium in a case of this kind, a singularly confused tremulous pulsation has been felt over the whole cardiac region. Various species of bellows-murmur will be audible where, the attachments of a valve having been extensively destroyed, the lacerated fragments flap to and fro in the corresponding orifice, and give rise to regurgitation, and probably also to more or less obstruction of the sanguineous current. This formidable accident has in some instances appeared to result from violent efforts, as in coughing; but has most probably in such cases been preceded by ulceration of the yielding part. Dr. Townsend has met with it in no less than three patients who were carried off by phthisis, and Bouillaud in a fourth case of the same kind, when the fits of coughing had been peculiarly violent: others have noticed it in connexion with hypertrophy and dilatation of the heart. When life has been prolonged for some time after its occurrence, all the usual symptoms of heart-disease have generally soon set in, and on dissection the ruptured tendons have occasionally exhibited granulations on the seat of the laceration.

Wounds of the heart, although in a great proportion of instances immediately fatal, have yet in some and not very rare cases been survived for some days or even longer. M. Ferrus tells of a madman who forced a short iron instrument between the fifth and sixth ribs into the heart, which it traversed obliquely from below upwards, passing through the left ventricle and septum, and who yet lived for twenty days afterwards. A soldier, who fell on his bayonet, so as to penetrate the left ventricle, not only survived for two days, but was able during part of the time to walk about almost as if no very serious injury had been inflicted; but at length went off suddenly in the effort of evacuating the bowels. There is a case on record, apparently well authenticated, of an individual who survived a gunshot wound in the chest for six years, a ball being found upon dissection in the right ventricle; and similar instances have presented themselves in the animals of chase, the ball being occasionally discovered embedded and incysted in the walls of the heart. In Dupuytren's *Leçons Orales* several examples of wounds of the heart which did not prove fatal for a considerable time after their infliction, are to be met with. The heart has occasionally been penetrated by the end of a fractured rib when the accident has occurred under the influence of great external compression, even when no laceration of the parietes had been caused; as, for example, in the case of a man who was jammed between the wheels of two carts, and who became immediately insensible, and speedily breathed his last.

According to M. Ollivier d'Angers, the chances of surviving for some time or even recovering completely, are considerably greater in the case of wounds of the auricles or right ventricle than those of the left ventricle; so likewise when the wound is very narrow and oblique. The circumstance of the weapon having remained fast in the wound has been known, as in the celebrated case of Epaminondas, to retard for a brief space the fatal hæmorrhage. Some of the examples of wounds of the heart alluded to above show that we should not absolutely and invariably despair of their recovery as of a thing utterly impossible.

The *treatment*, where the sufferer survives for a few hours after the closure of the external wound (which, to promote the formation of a coagulum, should be instantly effected) consists in free venesection, the application of cold to the exterior of the chest, and in keeping the individual, moreover, in a very cool atmosphere, exhibiting digitalis largely, and enjoining absolute quietude and abstinence. When the sufferer appears in imminent danger of suffocation from the internal effusion of blood, it might sometimes perhaps be proper to reopen the external wound, or if it be cicatrised, even to make a new aperture for the removal of the contained fluid, but obviously only in such cases where, from the return of the heat and colour of the surface, there is reason to suppose the hæmorrhage has at

length ceased. The subject of wounds of the heart, though strictly surgical, has been introduced here chiefly on account of the light which some acquaintance with it is calculated to throw on rupture of the organ, a condition with which it is so closely allied.

POLYPOUS CONCRETIONS OF THE HEART.

Origin and mode of formation.—Anatomical characters.—Symptoms.—Prognosis.—Prophylactic treatment.

DURING a considerable part of the last century, *polypi*, or firm and adherent coagula of blood within the cavities of the heart and great vessels were looked upon commonly as a fertile source of cardiac symptoms, many of the results now ascertained to have their origin in organic affections being at that time erroneously ascribed to them. Morgagni, and a few others of the more enlightened pathologists of his day, stood in opposition to the popular opinion on the subject, and denied their influence altogether, believing them to be merely a *post mortem* appearance, or, at the most, that the coagulation did not take place till the vital energies were on the very point of extinction. Both of these opinions were however, too exclusive. The more accurate investigations of later pathologists have proved satisfactorily, that such formations do occasionally originate during life, and that it is possible for them to be the source of very formidable symptoms; whilst, at the same time, they have rendered it evident, that in the vast majority of instances they occur either in the very last moments of existence, or after death. Hence the division of polypous concretions into *true* and *false*.

That the blood is capable of coagulating, and even becoming organized within its natural recipients in the living body, we have ocular proof, in what takes place in inflamed and obstructed arteries and veins; and analogy would lead us to expect a similar change in a portion of the contents of the heart under similar circumstances. Accordingly, it is in those cases, where the passage of the blood through the orifices of this organ are impeded, either by disease of the valves, aneurism of the aorta, or obstruction in the lungs, or where the lining membrane in contact with this fluid is inflamed, that this formidable change is most prone to occur; and this result seems often to be facilitated by a co-existing inflammatory condition of the blood itself, in which the fibrinous portion is in excess, as well as by any thing which enfeebles the organ and retards or temporarily arrests its action, as in the instance of protracted syncope. Hence the too free abstraction of blood, or the injudicious employment of digitalis, tartar-emetic, hydrocyanic acid, and other agents which greatly reduce the powers of life, are fraught with peculiar danger in the latter stages of heart-disease; in which the machinery of the circulation, already working imperfectly, is, by comparatively slight causes, readily brought to a final stop.

Polypi, when there is reason to suppose that they have been formed for some time previous to death, are peculiarly firm, tenacious and fibrous in their structure, and adhere so strongly by a filamentous union to the parietes and columnæ carneæ, with which they are interlaced, that they break across in attempting to detach them, and leave the surface of the organ rough with their fragments; whilst on scraping these away, the membrane underneath is often observed to be covered with bloody specks, indicative of incipient vascularity, induced apparently by the irritative contact of the newly-formed substance, and constituting a preparatory step to its organization. In addition to these appearances it has been pointed out by Laennec, that in place of being uniformly white or yellowish like recent con-

cretions, or the buffy coat of the blood, they are in parts of a pale flesh colour, or have a slight violet tinge, or finally are speckled over with bloody points, the rudiments of vessels: if of a still older date, they are perfectly consolidated with the endocardium, and are obviously as completely organized as polypi of the mucous surfaces.

Polypous concretions are more frequent in the right side of the heart than in the left; probably both in consequence of the frequent obstruction to the blood in its passage through the lungs, and of the extension of inflammation from the veins to its lining membrane, and the subsequent influence of this on the contained blood; as well as also from the introduction of purulent matter from distant parts, which comes into earliest contact with this portion of the organ, and forms there a nucleus, around which the fibrinous matter is deposited. When, however, extensive and firm coagula do present themselves in the *left* cavities, they ought always to be examined with peculiar care, as from the ordinary recession of the blood from this part of the organ immediately after death, there is the greater probability, *à priori*, that any such adherent masses have been formed during life.

Within the auricles, the concreted fibrinous matter ordinarily presents itself in the form of a thick lining over their internal surface, diminishing the capacity of their cavity, and sometimes by prolongation into the corresponding ventricles, embarrassing the action of the auriculo-ventricular valves, and compressing and flattening the muscular columns. When there is reason to suppose them of long standing, they are sometimes of a friable texture, resembling, to use the words of Laennec, an old rich cheese, or the decomposed fibrin in an old arterial aneurism.

The globular vegetations of Laennec, already spoken of, adhere occasionally by a pedicle of obviously more recent formation than themselves, and here, probably, have originated in the organization of a small coagulum of blood. They are of various sizes, from that of a pea to that of a pigeon's egg, are hollow, and contain within their cavity a sanguineous fluid, if recent, or a sanious or puriform one occasionally, if of longer standing. The wart-like vegetations of the valves, likewise, have been supposed by Laennec to have their source in minute polypous concretions, rather than in the effusion of coagulable lymph, as asserted by Kreysig and Bouillaud,—for their consistence and colour is very similar to these substances, and they display, moreover, frequently a violet tinge towards their centre, apparently the trace of the colouring matter of the blood. It would perhaps, however, be nearer the truth to say, that they originate sometimes in the one way, and sometimes in the other, or that both, when the excrescences are considerable, may be concerned in their formation. The very fact of their more frequent occurrence on the left side, where coagulation is a much rarer, and inflammation a more frequent event than on the right, must prevent us ascribing them solely or even chiefly to the source advocated by Laennec. The blood, when once it is coagulated, and organized within the heart, as in other situations, exercises the power of a living substance, and occasionally secretes within its new-formed tissue purulent, tubercular, or even osseous matter. The ossific concretion met with by Burns within the heart, which was about equal to a hen's egg in size, had probably originated in this manner.

Kreysig has attributed to the inflamed parietes of the heart and blood-vessels a power of determining the coagulation of their contents. That inflammation of the endocardium promotes in some degree the formation of polypous concretions is indeed highly probable, the effused lymph or pus forming a centre, around which the morbid solidification commences; but the existence of such a condition cannot be admitted as essential thereto. The low degree of inflammatory action requisite, in order that they shall become eventually solidly adherent to the interior of the organ, may as well be considered the result, as the cause, of their presence, and probably often ensues merely upon the pressure and irritation produced by them. It is not in the young and sanguineous most commonly, but rather in the

aged and debilitated, that this morbid appearance is met with; and the stagnation of the blood, however induced, seems alone, in any case, quite sufficient to cause its separation into its elements.

The *symptoms of polypous concretions* of the heart are nearly all referrible to the impediment to the circulation which they cause; as, for instance, the extreme dyspnœa, violent palpitation, and tendency to faint, sudden venous congestion, coldness of the skin and sense of sickishness, extreme distress and restlessness,—all of which are particularly characterized by the *suddenness* of their supervention. They are in some cases intermittent, making their appearance at uncertain intervals, and ceasing as instantaneously as they commenced. In such instances it seems probable that a portion of the newly formed mass floats loose by at least one of its extremities, so as to permit of its being carried temporarily by the current of the circulation into the auriculo-ventricular opening, or into the orifice of one of the great vessels. When the effects are more permanent, this circumstance may with great probability be ascribed to the greater magnitude and fixity of the fibrinous substance, and its constant interference with the play of the valves and with the freedom of the orifices of the heart.

The existence of polypus, says Laennec, is almost certain, when the motions of a heart, which had previously been beating regularly, become all of a sudden irregular, obscure, and confused to such a degree that we can no longer analyze them. The group of symptoms specified by Bouillaud as diagnostic, if they come on all at once, is as follows:—tumultuous pulsations of the heart, with dulness or obscurity of its natural sounds, together with a blowing, hissing, or musical murmur, orthopnœa, or a degree of difficulty of respiration bordering on asphyxia, in consequence of the obstructed state of the pulmonary circulation, extreme anxiety, congestion of the venous capillaries, and even loss of consciousness, coma, stertor, and occasionally convulsions resulting from the gorged state of the cerebral vessels, together with a remarkably small pulse and cold extremities.

If in the course of an acute inflammation of the heart, very great difficulty of breathing and extreme disturbance of the circulation set in suddenly, the rapid formation of the concretions in question may be suspected, with a high degree of probability, as their source; so likewise when there is sudden and very violent aggravation of an habitual dyspnœa.

The *prognosis* in this affection is, generally speaking, of the worst possible kind. As, however, coagula within veins have been known to undergo absorption, it is just within bounds of possibility, that those of the heart also when small may, in some very rare cases, be susceptible of spontaneous removal.

The best *prophylactic treatment*, according to Bouillaud, consists in the repeated abstraction of blood and free use of diluents in those cases of organic and inflammatory disease, in which their occurrence is most to be apprehended; but Dr. Hope very justly cautions us against the empirical or indiscriminate use of blood-letting in organic diseases of the heart, and especially in cases of dilatation and softening, or even in the advanced stage of valvular lesions when there is already great debility, as here it will not only fail to prevent the formation of polypi, but, like the imprudent employment of digitalis and nauseants under the same circumstances, will, by augmenting the languor of the circulation, directly favour their occurrence; whilst at the same time it tends unnecessarily to reduce the strength, accelerate the advance of dropsy, and the fatal termination of the complaint.

M. Legroux puts some faith in the exhibition of potass or soda, or their subcarbonates, from their power of diminishing the tendency of the blood to coagulate,—a property of the alkalies well known to Huxham, who deprecates their continued use, lest a dissolved state of this fluid should be induced. Dr. Copland thinks the sub-borate of soda the most influential agent for preventing the concretion, of fibrin, and dissolving coagulable lymph. The efficacy of mercury in effecting the latter object is also well known; but unfortunately in the vast majority of cases there is little time for the trial of this or any other remedy.

HYDRO-PERICARDIUM.

Causes.—Symptoms.—Treatment.

DROPSY of the pericardium may, like that of the other serous sacs, be either of an active or passive nature. The active species, or that depending on increased energy of the exhalants, is scarcely ever observed save as a consequence, or one of the latest stages, of inflammation of the pericardium, in which, when the original turbid, albuminous, or sero-purulent effusion has been absorbed, a transparent watery secretion gradually takes its place, which is either colourless, or with a slight greenish or pale yellowish tinge. Its occurrence in an active form, as an idiopathic and insulated affection, is so extremely uncommon, that it is difficult to point to an unequivocal example of it even in the writings of authors who have had the largest experience in diseases of the heart.

The passive form, or that resulting from impediment to the circulation, in consequence of obstruction in the heart or lungs, or from debility of the heart's action, is, on the contrary, by no means unfrequent; and its existence may be anticipated in most cases when there is a general dropsical tendency throughout the system, as well as in the final stage of many typhoid and malignant diseases, in which the fluids are deeply contaminated, and the capillaries relaxed; as in cases of cancer, for example, the worst forms of puerperal fever, the exanthemata, when accompanied by symptoms of putrescency, &c.

As to the quantity of effusion requisite to constitute hydro-pericardium, authors are not agreed. After death, whatever may have been its source, there is usually found a small portion of a serous fluid, amounting generally to a few drachms, within the pericardial sac, poured out either during the mortal struggle or after its termination. An effusion in such minute quantity, and taking place under such circumstances, does not fall within the scope of the term hydro-pericardium; nor does Corvisart recognise any thing under six or seven ounces as being entitled to the appellation. Laennec has not ventured to fix on any precise quantity as a minimum, contenting himself with saying, "a few ounces or a quantity exceeding that commonly found after lingering deaths." Bouillaud thinks that any thing above a couple of ounces may be considered as an example of dropsy of the pericardium, even though the mode of death may have been tedious. In many cases, however, there is no room for doubt as to the amount of fluid being sufficiently great to constitute a morbid state, as so much as one, two or three pints are sometimes found; and Corvisart mentions an instance where there was no less than eight pounds. The serous membrane in some of these cases has been observed to have an opaque whitish or macerated appearance.*

Amongst the symptoms occasionally present, are a sense of weight about the heart and inferior part of the chest, and oppression in the breathing depending probably on the pressure of the distended sac on the lungs, diaphragm, and neighbouring parts. The pulse is generally small, frequent and irregular, the integuments of the præcordial region being occasionally œdematous, whilst orthopnœa and tendency to syncope frequently co-exist. But all these symp-

* Under the title of *hernia pericardii*, a curious case has recently been described by Mr. Hart, in which, along with hypertrophy of the heart, and dropsical effusion into the pericardium, there existed a pyriform sac, likewise containing water, occupying the anterior mediastinum, and connected by an aperture at its narrower end with the pericardial sac, close to its reflection on the aorta. If not congenital, it was probably formed by gradual pressure of the effused fluid against a weak and yielding portion of the pericardium.—AUTHOR.

toms taken together are very far from being conclusive as to the existence of an unnatural effusion; nor even, though it should be present, do they necessarily depend on it, but much more frequently on co-existing organic lesion within the heart.

Senac declares he had seen a motion of fluctuation in the left side of the chest in cases of pericardial effusion; and Corvisart believed he had himself felt a similar motion in the same situation; but as nearly all subsequent observers have sought in vain to confirm these observations, it seems probable that the tremulous feeble impulse of the heart may have led to deception.

In cases of considerable effusion there is a striking prominence of the præcordial region with bulging of the corresponding intercostal spaces, together with a very extensive dulness, sometimes reaching even from nipple to nipple, and all along the sternum from near the second rib to the ensiform cartilage, in a pyramidal form with the base towards the diaphragm. The pulsations are frequently quite imperceptible, at least in the supine position, and when felt in the erect or prone posture often present themselves at successive moments, as Corvisart remarks, in different points of the præcordium, sometimes more to the right, sometimes more to the left than natural, giving the idea of the organ floating free, and altogether unrestrained by its enveloping sac; and they are usually, moreover, preceded, with an appreciable interval, by the commencement of the systolic sound. The sounds of the heart are feeble and distant, as heard immediately opposite the organ, but are much more audible at the top of the sternum opposite the arch of the aorta, and over the great vessels at the root of the neck; which latter circumstance aids us in distinguishing the case from one in which the heart is really acting very feebly.

Withal, the diagnosis of hydrops pericardii is extremely difficult unless the effusion be considerable: if it were less than a pint, Laennec thought the recognition of its presence impossible; and not by any means certain though of double or even triple this amount: but from its rarity as an idiopathic or leading affection he considered the discovery of it of the less importance. The greater tact which many now possess in regard to the practice of percussion, has, however, recently, in a considerable degree, diminished the difficulty of ascertaining the presence of pericardial effusion. Thus where it is only of a moderate quantity, M. Piorry speaks confidently of being able to detect it by making the patient whilst lying down turn alternately on the right and left side, and finding, by practising percussion successively in these two postures, that there is an obvious dulness which changes its place correspondently from the right edge and the upper part of the sternum to its left and upper part, and cartilages of the upper ribs.

Treatment. The active idiopathic form of hydro-pericardium, if recognised in its earlier stage, would of course require to be treated on the same principles as other active dropsies—by blood-letting, mercurials, purgatives, and counter-irritants, and subsequently by diaphoretics, digitalis, and other diuretics. And similar means in a modified form may afford useful aid in the passive or secondary variety; though here the proper management of the primary affection or organic cause forms, in cases which are not as yet altogether hopeless, the chief object.

As a forlorn hope the removal of the fluid by a surgical operation has been recommended by high authority, but the practice has as yet but little support from actual experience. The operation proposed by Senac was paracentesis of the pericardium, by the introduction of the trocar between the ribs. Corvisart thought that if an operation were justifiable at all, the best method of proceeding would be to lay open the parietes first, and then the pericardial sac cautiously with the knife; whilst Laennec expresses a preference for trepannation of the sternum just above the ensiform cartilage, as in this way we avoid laying open the pleuræ, and escape the error of Desault, who, attempting to perform the operation previously described, and having made his incision between the sixth and seventh rib of the

left side opposite to the apex of the heart, mistook a circumscribed pleuritic effusion for a distended pericardium, as was subsequently obvious on dissection. It has been proposed, somewhat too boldly we think, by Laennec, to inject the serous bag when emptied of its contents with some slightly irritating fluid with a view to inducing adhesion of its opposed surfaces, as in the ordinary operation for hydrocele. Bouillaud, without advocating either the operation or this addition to it, of which he has had no experience, yet thinks that what we know of the history of pericarditis and of its frequent termination in comparatively salutary adhesions, proves that the danger from such a proceeding is at least much less formidable than was once thought. Romero, who has thrice made an opening into the pericardium, in order to evacuate præternatural accumulations of fluid, and twice successfully, makes his incision between the fifth and sixth rib, first into the pleural sac; and then having satisfied himself of the existence of a fluid in the pericardium, he next lays this open with a pair of curved scissors, and lets its contents run off into the pleuræ, from whence they are subsequently drained away by placing the patient in such a posture as favours their escape by gravitation.

During the whole proceeding every care must be taken to prevent the entrance of air. This operation has the advantage over that of Laennec of evacuating any fluid which may happen, as is so frequently the case, to co-exist in the pleural sac; whilst at the same time if an error in diagnosis, similar to that recently alluded to, have been committed, it may be detected in the first stage, the actually existing effusion evacuated, and the additional risk of opening the pericardium avoided. But this or any other operation can scarcely ever be warrantable, except where the affection sought to be relieved is idiopathic, or depending on local inflammation or increased action of the serous membrane. Where there is organic disease of the heart or lungs, or constitutional diseases of the kinds already specified, no judicious practitioner would ever for a moment think of having recourse to it.

SECONDARY EFFUSIONS INTO THE PERICARDIUM.

FLUIDS of various kinds have been known to make their way into the pericardium from neighbouring organs in which they were originally poured out. Thus those of a *purulent* or *semi-purulent* description may get into the pericardial sac in consequence of the bursting of abscesses in that direction which had been formed in the cellular membrane of the mediastinum or in the lung, or from the irruption of a circumscribed pleuritic effusion through the medium of a gradual process of interstitial absorption.

An instance has been recorded by M. Alibert of the rupture into the pericardium of a very large *hydatid* or *serous cyst*, said to equal the fœtal head in magnitude, and which had been developed between the lung, diaphragm, and exterior of the pericardial sac. It had previously considerably displaced the heart to the left side. Its bursting in the manner indicated gave rise to sudden præcordial pain, orthopnoea, tumultuous action of the heart, and a membranous crackling sound, synchronous with the respiration; and was followed by death within a few hours.

A very interesting case has been recently described by Dr. Graves, of *abscess of the left lobe of the liver* making its way through the diaphragm into the pericardium, and also by three several perforations into the stomach. The abdominal tumour which had previously been very obvious, began, soon after the formation of these præternatural communications apparently, to diminish in size, and no longer imparted a sense of fluctuation, but became tympanitic, doubtless from the

entrance of air into it from the stomach. The secondary pericarditis thus induced manifested itself in the first instance by the sudden supervention of acute pain, by palpitation, and a sense of burning heat under the left breast; a rough bellows murmur and a species of creaking accompanied both sounds of the heart; and this was converted into a loud frottement when considerable pressure was employed. On the following day a metallic click indicative of the dropping of a fluid, and an emphysematous crackling were present. The patient being eventually run down by diarrhœa, caused by the escape of the purulent matter into the bowels, on dissection the pericardium, which was of four times its natural thickness, was found sprinkled internally with red dots, and arborizations, and coated over with lymph and minute semi-transparent granulations. A remarkable case has been recorded by Mr. Thurnam where the pericardium of a man who had been knocked down by a carriage, and thus almost immediately killed, was found filled with blood, though there was no rupture of the heart or great vessels within the sac. The effusion appeared to have its source in rupture of the veins in front of the trachea by the ends of the fractured clavicles, and to have forced its way through the intervening cellular membrane till it reached the apex of the pericardial sac, which it lacerated at length by its accumulation and pressure.

PNEUMO-PERICARDIUM AND HYDROPNEUMO-PERICARDIUM.

WHEN bodies have been kept for several hours after death before being opened, especially when the atmospheric temperature is somewhat high, air is very frequently found within the pericardium, as well as in other shut sacs, and escapes on an incision being made, with a hissing noise. But besides these instances in which the air has obviously its source in *post mortem* decomposition, examples, are occasionally met with where there is every reason to believe that it had existed during life, being evolved generally either during the final struggle or at the most but a few days before dissolution. It is in such cases almost invariably accompanied by a liquid effusion, from the decomposition of which, if of a fœtid character, it has for the most part its origin, though at the same time we are by no means prepared to deny the possibility of its being occasionally a product of direct secretion from the vessels. Its presence during life is indicated by a preternatural degree of resonance, of a tympanitic character, elicited on percussion in the præcordial region, as also by a sound of fluctuation produced by the motions of the heart through the elastic and inelastic fluids, as well as by forcible inspirations—a sound compared by Brichteau to the plashing of the wheel of a watermill. On dissection, if we would ascertain accurately the quantity and quality of the gaseous fluid present, the body should be opened under water, in order to facilitate its collection.

Laennec has expressed his belief that those cases in which the sounds of the heart are audible at some distance from the chest, depend for this peculiarity on the existence of air within the pericardium; but in support of this very improbable opinion he adduces no proof.

DISPLACEMENT OF THE HEART.

WE have already seen that the heart when greatly increased in size is felt to extend its pulsations to unusual situations, generally more to the left side or lower

down than natural; but besides this enlargement of the limits within which it is perceptible, it may be thrust out of its place by various extraneous causes, such as tumours in its vicinity, augmented dimensions of neighbouring organs, and morbid effusions. Such unusual position then, when ascertained not to have been congenital, is to be considered an evidence of some serious organic change having taken place within the thoracic or abdominal cavity.

The most frequent *cause* of this phenomenon is, unquestionably, a large pleuritic effusion, which, according to its situation and quantity may push the heart over either into the centre of the chest or to the right side, or, on the contrary, farther than natural to the left. Hæmorrhage into the pleural sac from injury will have similar results. Sudden and even permanent displacement has been known to result from external violence, as in the remarkable instance recorded by Dr. Stokes when it originated in the compression of the chest by a mill-wheel by which the heart was forced into the right side of the thorax. The individual, notwithstanding the severe symptoms which immediately supervened, survived the accident many years, and was occasionally even capable of taking very violent exercise, his heart ever after continuing to beat on the right side.

Aneurisms of the aorta, pneumothorax, or an emphysematous state of the lung, thoracic and abdominal tumours, ascites, and enlarged liver, are amongst the occasional causes by which respectively the heart may be displaced, either downwards, laterally, or upwards. Instances are alluded to by Dr. Stokes where this organ has been felt beating as low as the ninth intercostal space, in consequence of very extensive pulmonary emphysema, a morbid affection which, as has been remarked by an able anonymous writer in the *British and Foreign Medical Review*, must, by the pressure caused by it on the great vessels, tend greatly to the development not only of asthmatic symptoms but of actual organic disease of the heart. It has farther been supposed, with great probability by Dr. Stokes, that the heart may sometimes be drawn over in a very remarkable degree to the right side, by the absorption of a large pleuritic effusion in that part of the chest; especially when it takes place rapidly, and when in consequence of the lungs being closely and extensively adherent, the parietes of the thorax cannot fully accommodate themselves to the diminished contents of the cavity: and a case by Dr. Abercrombie, in the *Edinburgh Medical Transactions*, shows that a similar effect may sometimes be produced by atrophy of one lung, accompanied by an hypertrophic condition of the other.

In a case which occurred to Dr. Hope, in which the heart was just so far displaced towards the right, by a pleuritic effusion of the opposite side, as to be impacted between the sternum and unyielding spine, the augmented impulse was such as to have conveyed to a less experienced auscultator an erroneous idea of the existence of hypertrophy; and Dr. Stokes has known a similar effect produced by tubercular consolidation of the lung behind the heart.

In cases of diaphragmatic hernia, generally of congenital origin, the introduction of the intestines into one side of the chest necessarily displaces the heart more or less to the opposite side. Prolapsus of the heart, or that condition in which, from its unusual weight, and the relaxation of the parts by which it is suspended, it pushes the diaphragm before it, and encroaches on the abdominal cavity, is a very uncommon state, if indeed it is at all to be recognised as a distinct affection. Corvisart, who speaks of it, supposes it capable of causing severe pain in the œsophagus and cardiac orifice of the stomach, difficulty of deglutition, and imperfection of the digestive process, with frequent tendency to nausea and vomiting.

The *diagnosis* of displacement of the heart is based on the results of percussion and auscultation, and the examination of the præcordial region by the eye and by the touch, taken together with the history of the case, from which last we learn whether the phenomena are of comparatively recent origin, or at least not coeval with birth, and so independent of congenital transposition of the organ hereafter to be spoken of. When the displacement is very considerable, the functions of the heart may be much embarrassed, as is manifest from the severe palpitations occa-

sionally complained of in these cases. In the instances described by Dr. Graves and Dr. Stokes, where the heart was thrust upwards and to the right side, as high as the third intercostal space, by an aneurism of the abdominal aorta, the aneurismal tumour itself presented a double pulsation (the first stroke coinciding with the arterial pulse,) imparted to it obviously by the contact of the heart; whilst at the same time two sounds were audible corresponding to the natural double sounds of the latter organ. A similar double pulsation was observed by the same authors in a case of aneurism of the ascending aorta, and in two others of a like nature by Dr. Townsend.

HERNIA OF THE HEART.

HERNIA OF THE HEART, (*Ectopia cordis*,) though of congenital origin, may as well be briefly alluded to here. From original deficiency of a portion of the sternum, cartilages of the ribs, diaphragm, or abdominal muscles, the heart of the fœtus, or new-born infant, may be found protruding either on the exterior of the neck or chest, covered only with the common integuments; or into the abdominal cavity; or finally forming a portion of the contents of an umbilical hernia. Such examples of displacement as are here spoken of, generally occur in connexion with other congenital malformations, often from their very nature incompatible with the continuation of existence for any length of time after birth, and are hence obviously rather matter of curiosity than of practical interest. In some very rare instances, however, life has been prolonged even to a very advanced period, notwithstanding the existence of such singular malposition of the heart, as in the very remarkable case recorded by Deschamps, in which this organ was found on dissection occupying the place of the left kidney.

An interesting case of *partial "ectopia cordis,"* in an infant which survived its birth for three months, has been lately published by Dr. O'Bryen, of Bristol, in the sixth volume of the *Transactions of the Provincial Medical and Surgical Association*. In consequence of absence of the ensiform cartilage and of the part of the recti muscles and diaphragm usually attached thereto, a portion of the pericardium containing the apex of the left ventricle preternaturally elongated, protruded through the opening, and lay immediately underneath the common integuments, along with a portion of the transverse arch of the colon. In this tumour the following motions were observed:—1st, a lessening in size and contraction of its whole body, which was obviously the systole, as being synchronous with the first sound of the heart, and with the pulsation of the carotid; whilst at the same time its whole mass was carried forcibly downwards: 2d, a movement of dilatation during which the tumour became tense and appeared shortened; while at the same time it was much enlarged by as active a force as that of contraction, powerfully separating the fingers when an attempt was made to compress it; and immediately after which a sensation was imparted as if of a wave of fluid rushing into it and communicating a thrill to its walls. This movement of dilatation was synchronous with the second sound of the heart, but appeared to continue for some time after it. No distinct period of rest was perceptible after the dilatation. The heart in this as in Harvey's case appeared insensible to the touch. If the phenomenon accompanying the second sound be admitted to have been accurately observed, they afford stronger evidence in favour of an active power of dilatation in the ventricles, than any we have yet met with.

MALFORMATIONS OF THE HEART.

CONGENITAL MALFORMATIONS.

Transposition of the heart.—Acardia.—Bicardia.

CONGENITAL irregularities in the structure and relations of the heart, as may be deduced from the works of Winslow, Béclard, the St. Hilaires, &c., are referrible either to diseases occurring during the progress of the evolution of the fœtus, inclusive of interrupted development, or else to primitive anomalies in the germ (excess or malposition of parts,) or to both these sources together. Of the reality of the second of these causes, we have incontestable evidence in cases of *Transposition of the Heart*, in which the organ is not only placed in the right side of the thorax, but has, moreover, its aortic ventricle turned to the right, and the pulmonary ventricle to the left, and where a similar transposition of all the other thoracic and abdominal organs co-exists, the aorta running down along the right side of the spinal column, the vena azygos along the left; the lung on the right side having but two lobes, that on the left three; the liver, duodenum, head of the pancreas, and the cæcum being in the left side of the abdomen; the great curvature of the stomach, the spleen, and descending colon, lying to the right side.

Such anomalies of position are by no means incompatible with the due exercise of the functions, or with attainment of advanced age. Though very rare, the practical physician should be aware of the possibility of their occurrence, to prevent the mistaking the physical signs of such irregular congenital conditions for evidence of acquired disease.

Acardia. The heart has been discovered to be altogether wanting in some fœtuses; and this is said by Béclard to be universally the case in acephalous monsters, atrophy or absence of the upper part of the spinal marrow also ordinarily co-existing.

Bicardia. Two hearts have, on the other hand, been found within the chest of the fœtus in some extremely rare instances; but the accompanying pleurality of other organs naturally single, has indicated the source of this phenomenon to be the intermixture of two germs.

A case in which *three ventricles* were supposed to exist, has been recorded by Chemineau, but M. Is. G. St. Hilaire thinks it was probably only an example of a supernumerary septum.

A *second appendix* has been noticed, in connexion with the left ventricle by De Haen; and we have the authority of Breschet for believing that the pericardium has been observed to be entirely absent.

PRETERNATURAL COMMUNICATION BETWEEN THE TWO SIDES OF THE HEART.

Forms of preternatural communication between the two sides of the heart.—Cyanosis.—Symptoms of this lesion.—Progress.—Treatment.

OF this, the chief forms are permanence of the foramen ovale, abnormal apertures in other parts of the septum of the auricles, or in that of the ventricles, or in

the common point of junction of both septa, throwing the four cavities into one; origin of the aorta or pulmonary artery from both ventricles simultaneously; and continued patescence of the ductus arteriosus.

Many of these irregularities have, in several instances, been known to co-exist in the same individual, and frequently along with additional anomalies in the origin of several of the great vessels.*

When only one of these preternatural communications exists, by much the most common is the first of those mentioned above. A mere oblique opening between the over-lapping and imperfectly adhering edges of the foramen ovale does not, however, constitute an example of the malformation or lesion here spoken of; for a valvular aperture of this kind, in consequence of the counter-balancing pressure made on each of its sides simultaneously, will obviously not allow of the mixture of the contents of the adjacent cavities, and accordingly, though it is a condition so often found on dissection (in one out of every four subjects according to Bizot,) it is known not to give rise to any morbid symptoms. To have an injurious influence, it is necessary that the opening should be nearly at right angles to the septum, direct and patulous; and even here, many months of early infancy may elapse, ere any very obvious functional disturbance ensues; its first manifestations taking place occasionally during the irritation of dentition, or when the child begins to walk. The diameter of the open foramen ovale, in these cases, varies from two or three lines to upwards of an inch; whilst, in other instances, in place of one large opening, there are several smaller ones. M. Louis, after investigating the matter very scrupulously, has come to the conclusion that the perforated condition, not only of the auricular septum, but also of the ventricular, is congenital in almost every instance, as the edges of the aperture are rounded off, smooth, and polished, and occasionally membranous, or even somewhat tendinous, and without any traces of softening or other recent morbid process; whilst farther, the co-existent lesions are frequently of an obviously congenital nature, such, for instance, as the permanence of the ductus arteriosus, the origin of the aorta from the right ventricle, &c. The greater frequency of morbid alterations in the right side than in the left, contrary to what is observed in ordinary or acquired disease of the heart, is likewise adduced in proof of a primordial source; as is also the commonly existing contraction or obstruction in the orifice of the pulmonary artery. M. Louis does not, however, altogether deny that such openings might in some very rare cases originate in

* In a "Treatise on Cyanosis," by Dr. Gintrac of Bourdeaux, published in 1824, the following results have been deduced from 53 cases analyzed by him:—In 33 instances the foramen ovale was open; in 22, aorta arose from both ventricles; in 22, the pulmonary artery was contracted; in 14, the ductus arteriosus was open; in 5, ventricular septum imperfect; in 5, pulmonary artery obliterated; in 4, a single heart, *i. e.* only one auricle and ventricle; in 4, the aorta arose from the right, and the pulmonary artery from the left ventricle (foramen ovale open, and occasionally also the ductus arteriosus;) in 1, the aorta obliterated.

The following additional deviations from the natural state have been noticed by other authors:—The existence of two auricles with only one ventricle; or, in other words, total absence of the ventricular septum (*Wolff, Breschet Farre*); the four cavities thrown into one, from a deficiency of the septa at their common point of junction (*Thibert*, cited by *Laennec*); the pulmonary artery arising from both ventricles, and sending off the descending aorta,—the ascending originating naturally (*Sir A. Cooper*); the right auricle opening into the left ventricle, the ventricles communicating by a preternatural opening, and the auricles by the open foramen ovale (*Holmes*); the right ventricle bifid (*Kerkringius*); the arch of the aorta double (*Bertin*, *sen.*); the coronary veins opening into the left ventricle; the inferior or the superior cava opening into the left auricle; the foramen ovale closed in the *fœtus*; the valves of the heart, adherent along their edges, and consolidated into one substance, leaving only a small central aperture, or else perforated by numerous holes, or altogether absent (*Morgagni, Bertin, Laennec, Destrés*).—AUTHOR.

ulceration. The frequency of these exceptional cases appears to M. Bouillaud, on the other hand, much more considerable, in consequence of his having frequently noticed the co-existence of traces of inflammatory action in the lining membranes of the heart along with the unnatural communications alluded to, as well as from the occurrence of the symptoms taking place often suddenly, and for the first time in advanced childhood, or even in adult age. The valves, in particular, according to the same authority, very often present changes of an inflammatory nature, more especially those of the right side, and particularly of the pulmonary artery, the orifice of which is at the same time, and, as he thinks, from the same cause, very commonly contracted. We are bound, however, to confess that M. Louis's view of the case seems much the most consonant with the facts, and that the more frequent occurrence of the concomitant lesions or malformations on the right side appears altogether decisive against their inflammatory origin.

The heart in these cases is usually much enlarged, and transversely placed within the chest, the right cavities, and more especially the auricle, being almost invariably the subject either of dilatation, or hypertrophy, or both. When hypertrophy exists, it is not unfrequently, as Bouillaud remarks, of the concentric kind,—a circumstance which has been attributed by Bertin with more ingenuity than probability to the contact of the arterial blood unnaturally admitted into the right cavities. The additional work thrown on the right side of the heart, as well from the opposition encountered in the delivery of its contents through the contracted pulmonary artery, as from its unnatural participation in the labours of the general circulation, would seem sufficiently to account for its being the principal seat of enlargement. Besides, as Dr. Hope has remarked, this hypertrophy is often most considerable in those cases where, in consequence of the contraction of the pulmonary orifice, the current through the opening in the septum must decidedly have been from right to left, so that no arterialized blood could possibly have entered the right side.

There are a few cases on record which would seem to show that the foramen ovale may be violently reopened even in adult age by severe falls or blows, prolonged fits of coughing, or other fatiguing muscular efforts. The sudden supervention of the symptoms is not, however, sufficient to prove indubitably that such is the fact; it may, perhaps, be nearer the truth, even here, to suppose that the malformation alluded to had all along existed, but that it required some unusual derangement of the circulation in order to its revealing itself by external signs.

With regard to the septum of the ventricles, a preternatural opening may be met with in any part of it; but it is certainly found most frequently in that portion which adjoins the auricular septum, near to the insertions of the aorta and pulmonary artery. It is from this cause that the former of these vessels in particular has in these cases often an equal connexion with both ventricles.

From the almost invariable co-existence of some of the complications just alluded to (hypertrophy, dilatation, disease of the valves, narrowing of one or more of the orifices, &c.) it is nearly impossible to fix on any set of symptoms as strictly characteristic of the preternatural communications in question.

The bluish colour of the skin of the whole body, and of the face, extremities, and parts covered with a thinner cuticle particularly, which had commonly been looked upon as its pathognomonic sign, and which led to the use of the terms *cyanosis*, *morbus*, *cæruleus*, *the blue disease*, *blue jaundice*, &c., has been clearly shown by M. Bertin and by M. Louis to be often entirely absent; and even when present to depend with much greater probability on co-existent lesions capable of obstructing the course of the circulation, and so causing accumulation of venous blood in the capillaries. So likewise with regard to the frequent co-existing disorder of the heart's action, indicated by palpitations, purring tremor, bellows-murmur, fits of excessive dyspnoea, occasionally amounting almost to asphyxia, with proneness to syncope on the slightest exertions or unusual mental excite-

ment, irregularity and feebleness of pulse, and extreme suffering from defective power of generating heat,—these, together with an occasional tendency to serous effusions, being, as we have already seen, morbid phenomena of ordinary occurrence in cases of enlargement of the heart and obstruction of its orifices, whether from contraction or valvular disease. The narrowing of the pulmonary artery, which so commonly exists in cases of cyanosis, appears to be a very important element in the production of the peculiar appearance of the skin, as it must needs cause, as Morgagni has pointed out an embarrassment of the circulation through the right side of the heart, and consequent stagnation throughout the whole venous system; and especially at such moments when paroxysms of dyspnoea have been induced, and the circulation is peculiarly obstructed. That the deep colour of the skin, interior of the mouth, &c., occasionally observed, is not a necessary consequence of the mere communication between the two sides of the heart, we have proof, as M. Fouquier remarks, in the fact of its not being observed in the fœtus when such communication naturally exists, and when dark blood is necessarily circulated.

When the communicating cavities are of equal strength, it has been ingeniously suggested by M. Jules Cloquet, that no admixture of their contents in all probability takes place; whereas, if the left cavity exceeds the right in power, which in the natural state at least is always the case, the arterialized blood should make its way into the venous receptacles; so that if this view be correct, it may be only in a smaller number of cases that the contents of the right cavities are propelled immediately into the greater circulation; and even here it will not be in such quantity as to account for the deep blue tinge without taking the co-existing sources of obstruction into consideration. M. Louis, on the contrary, believes that, whether the two ventricles be equal in strength or not, no mixture will take place during their contraction, provided all their orifices be free; but as the pulmonary artery is very commonly contracted, a portion of the blood of the right side of the heart will usually make its way through the preternatural opening at the moment of systole, or if not then yet in every case during the diastole, or entry of blood into the cavity; so that a certain degree of admixture will occur in every instance: but this he believes to be quite inadequate to the production of the deep blue or violet colour of the skin, unless the co-existent sources of obstruction in the heart, and consequent stasis in the venous and capillary circulation be taken into account; for the fluids circulating in the cutaneous vessels in most parts of the body are in the natural state colourless; whilst, moreover, in M. Ribes' remarkable case, though the aorta sprung from the right ventricle, and the circulation of venous blood in the arteries must have always existed, yet no such peculiarity in the colour of the surface manifested itself till the third year, when it made its appearance in company with other symptoms of heart disease. M. Breschet, again, mentions an instance where the left sub-clavian artery arose directly from the pulmonary artery, and yet the colour of the corresponding limb was altogether free from any blue tinge.

Of all the *symptoms* usually attributed to the lesion under consideration, the one in which M. Louis is most disposed to confide is the recurrence of *suffocating paroxysms* at periodical or at least at very short intervals; these paroxysms being often accompanied or followed by fainting, and induced by very inconsiderable causes; whilst, as for the blue colour, it may be either present or absent. The existence of a bellows murmur and thrilling tremor, if permanent and unattended with a marked disposition to dropsy, is considered by Bouillaud as strongly confirmatory of the above symptoms. The blueness of the surface, we repeat, may or may not exist; and even when present, Laennec thought it was often rivalled in intensity by the dark colour of the skin in certain diseases of the lungs, and more especially emphysema; but this Dr. Hope doubts. As active enlargement of the heart is an almost invariable accompaniment of these preternatural communications, there is commonly a very considerable extent of dulness in the præcordial region, along with increased impulse, and at the same time often a superficial

hissing murmur, with the first sound, about the middle of the sternum, in consequence either of the contraction of the pulmonary orifice or of the unnatural aperture through the septum, or both.*

In infants with this malformation, even the effort of sucking is often sufficient greatly to embarrass the respiration and circulation; and the suffocative paroxysms so induced are occasionally accompanied by convulsive movements.

In childhood there is an inability to participate in the sports of that age; the sufferer is disposed to crouch over the fire even in summer, and is very easily benumbed in cold weather. The ends of the fingers and toes are often bulbous as well as discoloured; there is a tendency to cough on making use of any muscular exertion, and pulmonary congestions very frequently manifest themselves under the influence of slight exciting causes. The discolouration of the skin and interior of the mouth is sometimes, as Dr. Hope expresses it, as deep as the stain of the small black cherry. The contractions of the pulmonary artery, which so commonly exists, is looked upon by M. Louis not only as of indubitably congenital origin, as already stated, but also as a chief cause of the prevention of the closure of the aperture in the septum, by means of the over-distention of the right cavities kept up by it.

The *progress* of the disease is very variable. In most cases the sufferers are cut off early, in infancy or childhood, in the midst of one of the suffocative paroxysms: in some instances a precarious existence has been prolonged to middle life, or even to advanced age. One of the cases alluded to by M. Louis reached to the fortieth year, and another to the fifty-seventh, and then terminated by the supervention of a new disease.

The *treatment* of this affection is simply palliative, as its organic cause is irremediable. The judicious management of co-existing diseases in the heart and other organs, together with exemption from mental and corporeal excitement or over-exertion, and from every thing which might hurry the breathing or the pulse, the early reduction of all inflammatory attacks, the enjoyment of a pure mild air, the avoidance of cold and damp, together with great temperance, and a due regulation of the digestive functions, and the promotion of all the natural excretions, are the points towards which attention should chiefly be directed.

* The murmurs indicative of a communication between the two sides of the heart, though not yet fully ascertained, Dr. Hope conceives would be nearly as follows:—"An unusually loud and *superficial or near sounding* murmur with the first sound, *immediately* over the semi-lunar valves (*i. e.*, about opposite to the inferior margin of the third rib) is generally seated in the mouth of the right ventricle, and may proceed either from a contraction of the pulmonic valves or orifice, or from an opening out of the right into the left ventricle, or from both these lesions conjoined. If it proceed from contraction of the pulmonic valves or orifice alone, it will be audible along the course of the pulmonary artery, up to the second intercostal space, much more distinctly than along the course of the aorta, and will be attended with a thrill. If it proceed solely from an opening out of the mouth of the right into the left ventricle (the pulmonic orifice being either healthy or totally obliterated,) it will be more audible along the course of the aorta than along that of the pulmonary artery. If it proceed from the double lesion, *viz.*, a contracted pulmonic orifice, and an opening into the left ventricle, it will be loudly audible along the course of both vessels, and a thrill will be felt over the pulmonary artery. When these signs of a lesion in the mouth of the right ventricle coincide with cyanosis, the evidence of a communication between the two sides of the heart is almost positive; and as hypertrophy of the right ventricle is usually a concomitant, its presence is a corroborative circumstance. When the signs in question do not coincide with cyanosis, an appeal must be made to the history of the case. If it appear that the patient has exhibited the symptoms of organic disease of the heart from early infancy, yet has never been affected with endocarditis, to which the valvular disease could be ascribed, there are strong probabilities of a congenital malformation, and presumptions of a communication between the two sides, though without so considerable an intermixture of blood, or so great an obstacle to its ingress into the lungs, as suffices to occasion cyanosis.—AUTHOR.

DISEASES OF ARTERIES.

FUNCTIONAL DISEASES OF ARTERIES.

Functional disorder of the aorta and arteries arising from it.—Neuralgia.—Inordinate pulsation.—Treatment.

IN treating of the disorders of the arterial system which fall more particularly under the care of the physician, we commence with those of a purely functional kind, passing afterwards to others of an inflammatory and of an organic nature.

1. *Neuralgia.* The most remarkable of the nervous and functional derangements of the arterial trunks, consist, first, in an intense neuralgic pain in their course, having its seat most probably in the minute ramifications of the ganglionic nerves which form a close network around them and penetrate into the substance of their walls; and, secondly, in such inordinate pulsation as is independent of any appreciable inflammatory action or organic change in their coats. Both of these affections may exist simultaneously; but the latter, or increased force of pulsation, occurs much more frequently alone, and the affected artery generally presents during its continuance the additional phenomenon of bellows-murmur, which is occasionally audible at the same time in other portions, also, of the arterial system. This sound is ascribed by Bouillaud, Williams, Piorry, and most others who have alluded to it, as we have already seen, to constriction of the tube in which it originates; whilst Dr. Corrigan, on the contrary, recognises its immediate physical causes in the laxity of the coats of the vessel below such obstruction facilitating their vibrations, and in the current-like flow of the blood which plays against them and throws them into tremulous motion (p. 263.) The occasional existence of a variable and intermitting bellows-murmur behind the upper part of the sternum, in the absence of all evidence of organic disease, shows that the thoracic portion of the aorta, or the great vessels arising from it, may sometimes be the seat of increased action of the kind here spoken of; but it is in the upper part of the abdomen, where the aorta and its branches fall more within the reach of the sense and touch, and where their vitality is most exalted, if we may judge by the innumerable nervous filaments by which they are embraced and penetrated, that this phenomenon is most frequent, and has particularly attracted attention under the title of—

2. *Inordinate, abdominal, or epigastric pulsation.* The diastole of the abdominal aorta, which may often be distinctly felt, even in the natural state in thin individuals, on making firm pressure with the points of the fingers in the epigastrium, a little to the left of the median line and downwards, becomes in the morbid condition here spoken of much augmented in force, and disagreeably perceptible to the subject of it, who, in addition to the physical uneasiness caused by it, suffers still more from the alarming apprehensions he often entertains as to its nature and tendency. It was frequently, indeed, mistaken even by medical men in former days for evidence of the existence of aortic or celiac aneurism, till in the progress of pathological investigations, and especially those made by Mor-

gagni, and subsequently by the late Dr. Baillie, it became certain that it was altogether independent of organic disease in a very great proportion of these cases where it occurred.

But though epigastric pulsations have thus been deprived of much of their formidable character, it still remains in many instances dubious to what particular state they owe their origin, the cause by which they are induced, as well as the precise condition of the vessel in which they have their seat, being both often almost equally obscure. It is even sometimes very difficult to decide whether it is not in the celiac axis or some of the subordinate branches of the aorta rather than in this vessel itself that they take place. Their variable and intermitting nature, the suddenness of their appearance and cessation, the freedom from any severe fixed pain in the spot or in the surrounding viscera, as well as in the corresponding portion of the spine, such as might indicate internal pressure, together with the absence of all evidence of mechanical obstruction to the circulation or permanent alteration in the caliber of the vessel, prove them to be altogether independent of organic narrowing of the artery on the one hand, as well as of its enlargement or aneurism on the other. The pulsation, occasionally accompanied by a feeble murmur, especially when in the horizontal posture, is confined to the natural line of the vessel, its extent in the lateral direction being much more limited than in the longitudinal, as becomes manifest on making firm pressure with the stethoscope successively over its course, and to each side of it: and though it may sometimes be accompanied by a degree of fulness in the epigastric region, yet this is commonly readily distinguishable from that caused by aneurismal tumour, by its being of less definite outline, as well as less permanent, depending as it often does on flatulence or fecal accumulation in a portion of the colon or of the small intestines, which has the effect at once of irritating the vessels by compression, and of conveying towards the surface the bellows-murmur and impulse so produced. The short jerking impulse, moreover, is commonly very different from the gradual and expansive heaving of an aneurism. The attentive consideration of the accompanying symptoms will tend still farther to elucidate the diagnosis.

Pulsation of the kind alluded to is peculiarly frequent in hypochondriacs, and, in those whose digestive organs are deranged, or in whom an habitual effusion of blood from the hæmorrhoidal veins has suddenly ceased, as well as in individuals of a highly nervous temperament, in anæmia, and particularly in hysterical and chlorotic females, when labouring under deficiency or irregularity of the menstrual evacuations. Its connexion with a disordered state of the abdominal nerves is recognised by Senac, Albers, Burns, Laennec, and Hope. M. Dance conceives it to originate more particularly in a morbid state of the functions of the solar plexus, its ganglia and ramifications, an opinion which has likewise been advocated by Dr. Law and many others, and very recently sustained with much zeal by Mr. Faussett, who, however, at the same time deprecates the idea of its being a merely nervous affection in the common sense of the term, as he believes that there exists in every instance more or less congestion of the ganglionic centres, as well as of the viscera which they supply, these probably reacting mutually on each other, and as well as on the walls of the aorta through the medium of the nervous filaments distributed to them. That such a local plethora exists, or even in some instances a state of sub-acute inflammatory action, he is led to believe by the frequent presence of tumefaction in the epigastric region, accompanied by tenderness on pressure, and a sense of anxiety or sinking at the pit of the stomach, or just over the suspected ganglia; as well as from the efficacy of active depletory measures in the reduction of the morbid pulsation and attending symptoms. It is indeed now generally admitted that abdominal plethora is concerned in the production of the pulsation in question in a great many instances, but the peculiar temperament and the state of the heart's action in particular are also very important elements in perhaps a still greater number. Some writers, amongst whom Dr. Johnson is to be classed, seem dis-

posed to confine its occurrence to those cases in which there is either an excited state of the arterial circulation generally (so often observed in connexion with gastric irritation and its sympathetic influence on the heart,) or else a local obstruction in the capillaries of some of the abdominal viscera, as in congestion and inflammation of the liver, fecal accumulation, &c., acting as it were like a ligature, and rendering the pulsation of the arteries leading to them more obvious.

Two remarkable cases have been recorded by Albers, in which this morbid symptom ceased immediately on the passage of abundant dark evacuations from the intestines, proving its occasional dependence on deranged secretion of the liver and mucous membrane; and a still more striking example is mentioned by De Haen, where it existed in a most violent degree along with many of the worst symptoms of aggravated organic disease of the heart, all of which vanished at once on the occurrence of a spontaneous purging of greenish fetid matter. Cases of such happy termination must not, however, make us forgetful of the fact of the frequent connexion of aortic pulsation with real structural disease of the heart, and more especially with hypertrophy.

The co-existence of tenderness in the spine, in some cases of abnormal pulsation, has been particularly insisted on by Mr. Teale. Dr. Baillie speaks of an instance of its sudden cessation on the supervention of gout in the extremities. Hæmorrhage from the gastro-intestinal mucous membrane has been occasionally preceded or accompanied by this phenomenon, and a case of the kind, which, from the supervention of hæmatemesis on violent action in the aorta, had been mistaken for rupture of an abdominal aneurism, is alluded to by Dr. Law. Increased abdominal pulsation, if attended with fever and unaccompanied by a proportional increase of strength of the pulse of the wrist, has been pointed out by Dr. Stokes as one of the symptoms of intestinal inflammation.

Where epigastric pulsation occurs in hypochondriacal and nervous subjects it is very commonly attended by a sense of fulness and throbbing in the head, with coldness of the feet, and most frequently makes its appearance in the sedentary, and those about the middle period of life. When but of momentary duration it very often depends,—according to the remark of Laennec, the correctness of which we have had frequently occasion to verify,—on imprisoned flatulence in the super-incumbent intestine, concurring occasionally with a state of nervous excitement of the heart's action. When of a more permanent character it has been known to originate in the pressure of enlarged viscera and other abdominal tumours, which at once narrow the caliber of the artery and transmit its augmented impulse to the surface of the abdomen.*

Treatment. As to neuralgia affecting the arteries, it is to be combated on the same principles as when it occurs in other parts. (See NEURALGIA OF THE HEART, &c.)

On the treatment of abdominal pulsation it is likewise unnecessary to enter at length, seeing, from all that has been said above, that it is obviously nothing but a *symptom*. The morbid conditions from which it springs are, as we have just shown, various, and consequently the remedial measures appropriate in different cases must be no less dissimilar. It may, however, here be said generally, that the first object to be aimed at in almost every case is to get the secretions into a healthy state, especially those of the chylopoietic viscera, seeing that dyspepsia

* A distinct "encephalic bellows-murmur" has been noticed by Dr. Fisher, an American physician, on the application of the stethoscope to the upper part of the head in cases of meningeal inflammation, and is supposed by him to be connected with compression of the numerous arteries at the base of the brain. Dr. Forbes, to whose early and able advocacy the cause of auscultation has been so much indebted in this country, pointed out, many years ago, the occurrence of a similar phenomenon in the mass of the thyroid gland, when enlarged, as in cases of bronchocele,—the sound originating probably in compression of the carotide, or their branches.—AUTHOR.

and derangement of the alvine evacuations are so often present. In females, moreover, the regulation of the uterine functions is never to be overlooked.

Where there is evidence of a plethoric condition of the organs within the abdomen, in addition to the steady use of mild aperients, especially of the saline class, together with the occasional exhibition of a mercurial purge, restriction to a vegetable or farinaceous diet, and the renunciation of wine, coffee, and other stimulants is indicated; and in addition to these measures the local abstraction of blood, either from the epigastrium or hæmorrhoidal vessels, or in some instances even general blood-letting, may be proper, along with counter-irritation, either over the seat of the abdominal pulsation, or in the portion of the spine just opposite to it, which latter situation should of course have the preference in those cases where spinal irritation co-exists. In particularly obstinate cases, where the pulsation and visceral congestion with which it is associated are the source of very serious and prolonged annoyance to the patient, it may be justifiable to follow the example of Mr. Faussett, and employ, in addition to the antiphlogistic remedies already detailed, mercury in combination with antimony and sedatives in such a manner as slightly to affect the mouth, and subdue any existing local determination.

Hohnbaum, a recent German writer on the subject of epigastric pulsation, having himself suffered for years from it in connexion with various dyspeptic symptoms, venous plethora of the abdomen, debility of body, and despondency of mind, found more relief from the use of the aperient waters of Carlsbad, along with the accompanying change of air and scene, and relaxation from the fatigues of his profession, than from all the very numerous and diversified methods of treatment he had previously essayed.

Where a chlorotic or anæmic, a nervous or irritable state of the system constitutes the predominant feature of the case, all weakening losses of blood and excessive evacuations should be controlled; and the employment of tonics, and more especially iron or bark; the tepid or cold shower bath, are called for, along with a liberal supply of light nutritious food, the enjoyment of a dry bracing atmosphere, and daily exercise in the open air. These, together with early hours, cheerful society, and freedom from anxiety of every kind, are the means which give the patient the best chance of at once getting rid of the annoying symptom we have been considering, as well as of the numerous associated derangements in other parts.

ARTERITIS, OR INFLAMMATION OF ARTERIES.

Anatomical characters and effects of arteritis.—Predisposing causes.—Exciting causes.—Symptoms.—Treatment of arteritis and its consequences.

THERE has been much difference of opinion amongst pathologists as to what constitutes adequate anatomical evidence of the existence of arteritis: redness alone certainly does not, as staining of the inner membrane, and even of the cellular tissue on its adherent surface, is often a mere cadaveric phenomenon, the joint result of softening of the tissue from incipient putrefaction, and of the contact of the contained blood, which, especially when in a fluid or imperfectly coagulated condition, as for example in typhoid diseases, or after a long final agony in various chronic disorders, readily affects, by imbibition, the interior portion of the arterial tubes. Redness from this source is most apt to be met with when the temperature is elevated, and the examination of the body has not been made till several hours after death.

In the investigation of this subject, a vast number of horses were opened by MM. Rigot and Trousseau at various intervals after they had been slaughtered, and they assert that in no instance did the appearance in question present itself to their notice when sought for immediately after the creature had fallen, though it was common enough after the lapse of some hours; a fact which proves that redness of the arteries proceeding from a morbid or vital action, must be, at least in these animals, of very rare occurrence. But we must here beware of generalizing too hastily and exclusively. In particular epidemics amongst horses, such as that which existed at Paris in 1825, and which was characterized by gastro-enteritic symptoms, and a difficulty of breathing independent altogether of pulmonary inflammation, redness of the interior of the arteries as well as of the heart, apparently of an inflammatory nature, was occasionally detected by Dupuy, Bouley, and Andral, even immediately after the diseased animal had ceased to breathe. All analogy, indeed, would prepare us to expect that inflammation should sometimes originate spontaneously, or at least independently of all direct external injury, in the membrane in question. In the human subject, where we find a diffused redness of the internal tunic, delicately shaded off on its edges, accompanied by softening, pulpy thickening, and infiltration of this and of the middle coat and their connecting cellular membrane, along with unusual facility of their separation, and distinct increase of vascularity in the same situations, the probability of these changes depending on inflammatory action is very strong; and where coagulable lymph or pus has been effused on either the free or the attached surface of the lining membrane, or ulceration taken place, the evidence of the existence of this morbid process becomes complete. Now all these appearances have occasionally, though rarely, been met with independent of all external violence done to the vessel, proving sufficiently that the arterial tissue enjoys no absolute exemption from spontaneous inflammatory action. The middle or fibrous coat in these cases loses much of its natural elasticity, and becomes remarkably fragile, and even the external or cellular one, though much less prone to disease, is somewhat softened and less capable of suffering distention with impunity.

It is obvious that from the facility with which morbid effusions are washed away by the passing blood, there may be many incipient cases of real inflammation in the interior of the vessels, as to the true nature of which, as judged of by the appearances on dissection alone, we shall yet remain in doubt, in consequence of the absence of the most characteristic and indisputable of the evidences mentioned above.

It has been satisfactorily proved by M. Bizot, by tracing the transformation step by step, that the white cartilaginous patches so often observed in the interior of the arteries originate in the albuminous exudations of acute arteritis, which, at first of a viscid gelatinous consistence, and of a pale or rosy hue, become gradually whiter and firmer, and eventually supplant the lining membrane, on the inner or free surface of which they were originally poured out. The result of his researches does not, however, countenance the common opinion of these patches being a preparatory state to ossification; for he has never succeeded in detecting them in the state of transition. (*Brit. and For. Med. Rev.*, No. xi.)

The ulcerations occasionally observed in the lining membrane are very commonly connected with atheromatous or osseous depositions in the fine connecting cellular membrane between it and the middle coat, which by the pressure and irritation to which they give rise eventually make their way through the delicate inner tunic, so as to come into actual contact with the blood.

Whether these deposits ordinarily originate in a local inflammatory process of a sub-acute or chronic character, is still a litigated point; but as to their influence in destroying the elasticity and producing ulceration and perforation of the coats, gradual aneurismal tumours, or sudden and fatal rupture of the vessels, there can be no question.

Sometimes all the layers of an artery are found of an unnaturally white colour,

and more opaque and less elastic than usual: a condition in which, obviously, they can no longer respond to the heart's impulse with the same safety to their own tissue.

The atheromatous patches so often observed in the aorta and larger arteries, consisting of matter of a cheesy friable consistence and yellowish hue, commence, according to Bizot, who has very minutely investigated this point of morbid anatomy, by innumerable minute granules of a pale yellowish colour, situated between the middle and inner coats, adherent to both, and unattended by any redness or trace of inflammatory action in the surrounding tissues. These granules, as they accumulate, coalesce into groups or masses, which subsequently may become the seat either of a process of ulcerative softening, or else of ossification. When the former of these two changes occurs, the softened matter in some degree resembles pus, and the appearance so produced has by some observers been described, but erroneously, as an abscess or a pustule in the interior of the wall of the vessel, whereas it approximates in reality much more nearly to the process by which tubercles become softened. The calcareous deposit commences by minute, hard, semi-transparent specks in the substance of the atheromatous patches, especially where in contact with the middle coat, which becomes wasted beneath their influence, as does likewise the inner membrane even to its total destruction. As the atheromatous matter frequently lines the back of the whitish or cartilaginous patches mentioned above, and may equally here become the seat of bony deposition, the common error of ascribing the osseous scales, in general, to the transformation of previously existing cartilage is, in some degree, accounted for. The smaller arteries may be entirely obstructed by these morbid deposits, and the elasticity of the larger being greatly impaired, they readily become the subjects of gradual dilatation. These perversions of nutrition take place at a much earlier period of life in the lower extremities than in the upper, and generally in symmetrical order; that is, the same arteries and corresponding portions of them become, for the most part, almost simultaneously affected on the two sides of the body. The yellow spots make their appearance first in the arteries nearest the aorta; the ossific deposits, on the contrary, earliest in those most remote. Arterial lesions are most frequent in the proximity of the branchings of the vessels.

The extent to which calcareous degeneration may take place is very considerable, as it manifests itself sometimes not only in the aorta and its primary branches, but also in the arteries of the heart, brain, and extremities, which may thus be converted into rigid tubes, or have their interior irregularly lined with a scaly deposit like loosely adherent fragments of egg-shell, a condition which interferes much with the natural functions of these vessels, and lays the foundation for apoplexy, aneurism, gangrene, and other formidable species of disease. It adds much, likewise, to the uncertainty of the result of all surgical operations in which vessels have to be tied, both on account of the risk of secondary hæmorrhage, and also, in some cases, from the difficulty of the establishment of the supplementary or collateral circulation. According to Morgagni, sudden death is not unusual in individuals in whom no other morbid appearance is detected besides numerous ossific scales, or ulcerative depressions in the spots where these scales have become detached. A very singular case has been recorded by Dr. Abercrombie of the total cessation of pulse in every artery in the body except the carotids, in consequence of ossification of their coats; and a still more remarkable one is detailed by Mr. Adams, in the *Dublin Hospital Reports*, where there was no pulse at all in any part, and even at the heart no indication of motion beyond a very feeble undulating sound. On dissection the aortic valves were found ossified, and the coronary arteries of the heart obliterated for near an inch at their origin,—a state of things which accounted at once for the diminished action of the heart and impeded flow of the blood. The principal remaining symptoms were dyspnoea and sleeplessness, of many weeks duration, terminating in stupor and death. In a case spoken of by Andral, in which the pulse in the left wrist was peculiarly feeble, a round cretaceous tumour was discovered on dissection within the brachial artery, nearly

filling its caliber. Such loose concretions originate probably, for the most part, in the walls of the vessel from which, in process of time, they become detached, and may be the source of complete obstruction in the smaller branches.

All the morbid deposits above spoken of are of peculiarly frequent occurrence in the aorta, especially about its commencement and arch, and account, in part, for the very great frequency of dilatation in this portion of the vessel. Ossifications are of so common occurrence in advanced life, that their absence now excites more surprise than their presence. That they should be so much more frequently met with in the aged than in the young shows that, even if their origin be sometimes determined by chronic inflammation of the coats of the vessel, still a certain predisposing condition of the system is, at least, equally concerned. The arteries of the young are not, however, altogether exempt from this change, and examples of it have been discovered even in the bodies of infants. Its extensive existence, at a later period of life, serves to account for some anomalies in the pulse of old people, its hardness and occasional difference at the two wrists, and the slight degree in which it is effected by venesection, as well as for the difficulty with which the circulatory system, in many instances, accommodates itself to this evacuation.

Ossification of the vessels is almost confined to those which carry red blood: it has, however, in some very rare instances, been noticed in the pulmonary artery. The cartilaginous change is less infrequent.

The inner membrane of arteries is sometimes found in a state of chronic softening; and, when in such a condition, its laceration may be determined by very slight causes, such as would have no influence on it in a state of health. In some very interesting cases of this kind, which have been published by Mr. Turner, portions of the interior lining were found retracted and rolled up within the canal of the vessel. In this manner, and by the accompanying effusion of plastic lymph and the formation of a coagulum of blood, the artery may become completely obstructed and obliterated in a portion of its course; all pulse below the spot ceasing immediately on the occurrence of the accident. The seat of the local lesion is commonly indicated by the sudden supervention of pain and swelling. Occasionally the arteries of the upper and of the lower extremities become thus affected in succession on the employment of the slightest exertions, indicating a very extensive affection of the arterial system. In most of the cases recorded there had been previous febrile symptoms of some continuance and originating commonly in cold. Paralysis and gangrene of the limb, and death, were occasional consequences of the impervious state of the artery. The cold dead state of the part was, in some instances, supplanted by obvious inflammatory reaction on the re-establishment of the collateral circulation. In a case which occurred to Dr. Abercrombie ulcerations were found to co-exist within the aorta; and this, as well as the cause and symptoms of the disease, all seem to point to an original inflammatory action as the source of the softening of the vessel. Some interesting cases bearing on this connexion of gangrene with arteritis have also been published by Dr. J. Graves and Dr. Stokes in the 5th vol. of the *Dublin Hospital Reports*.

The obliteration of arteries may also take place from the mere inflammatory thickening of their coats, or the effusion of lymph into the cellular membrane connecting them, or into the interior of their canal without any previous rupture of the inner coat. Even the innominate has been found almost filled by an unnatural growth from, or hypertrophy of, its lining membrane, and the aorta itself, quite independent of congenital narrowing, has thus, in more instances than one, been detected in a state of perfect obliteration, whilst the arteries which arose above the obstructed point, being much dilated, in a great degree supplied its place.

The thoracic aorta has, in several instances, exhibited an *abrupt constriction*, especially at that point where the ductus arteriosus penetrates its coats; a condi-

tion attributed, with much probability, to the communication of the contractile action naturally taking place in this passage at the period of birth to the adjacent fibres of the arch.

Amongst the *predisposing causes* of arteritis have been enumerated a plethoric and irritable state of the body, habitual over-distention of the vessels by frequent violent exertions, the excessive use of spirituous liquors, and hypertrophy of the heart, as likewise a gouty or rheumatic habit, to which Scarpa, Hodgson, and some others have added, on more dubious evidence, the morbid conditions of the constitution induced by the poison of syphilis, or the long-continued use of mercury.

The *exciting causes* of inflammation of arteries, independent of wounds, pressure or ligature, sudden and violent elongation of the vessel, and other external injuries by which the inner coat is so often lacerated, may be referred generally either to exposure to cold, violent mental emotions, excessive bodily fatigue, or else to the spread of inflammation from the cyst of an abscess or ill-conditioned or gangrenous ulcer; to unhealthy pus and various morbid poisons, such as that generated in puerperal and other malignant fevers, glanders, &c., introduced into the torrent of the circulation; and, finally, to the repulsion of measles or small-pox, scarlatina, or erysipelas, or other acute cutaneous inflammations. In several of these latter cases the inflammation of the lining of the vessel has presented somewhat of an erysipelatous character, spreading rapidly towards the heart from being unattended by any effusion of coagulable lymph by which its progress might be limited; whilst the accompanying fever is commonly of a low or malignant kind.

The *symptoms* of arteritis even in its acute form are very obscure. Those usually ascribed to it are, increased energy of pulsation in the inflamed vessel, a sense of heat and pain along its course, together with restlessness, extreme anxiety, and a frequent feeling of sickness or faintness, and all the other common sympathetic effects which the inflammation of any important part of the body exerts on the heart, brain, skin, digestive organs, &c.

The opinion of Frank, that arteritis gives rise to a peculiar fever of great intensity, has not, however, been confirmed by subsequent observers. In the carefully noted cases of Mr. Turner, already alluded to, the fever did not usually run very high: nor indeed is there any one of the symptoms enumerated above, which can be considered as truly characteristic. We are not as yet, it must be confessed, in possession of any unequivocal diagnostic mark of the inflammation spoken of: and it is for the most part only by negative signs that we can attain even to a probable suspicion of its existence when it occupies the interior of the body—namely, by the absence of all evidence of any other thoracic or abdominal inflammation, aneurism, or other tumour pressing on the vessel in its course, as well as by the absence of reaction from the loss of large quantities of blood, or of the nervous pulsations already described, and in short of every other cause by which either the energy of the action of the suspected artery might be augmented in the first instance, or its channel subsequently obstructed.

As the disease proceeds, if a large extent of the arterial lining becomes implicated, or effusions of a purulent or sanious character take place into the canal of the vessel, the accompanying fever changes from the inflammatory to a low typhoid type, the pulse becoming very quick, feeble, and unequal, the respiration hurried, the capillary circulation embarrassed, and at length muttering delirium and spasmodic twitching of the limbs supervening, the scene soon closes, and on dissection effusions are often found to have taken place into the several serous cavities. Where, however, healthy coagulable lymph has been effused, and the inflammation thus limited to a single artery, the caliber of which becomes obstructed, and the communication with the rest of the system impeded, the effects of the morbid process are of a less rapid and certainly fatal character. If it be confined to the artery of a limb the part becomes pulseless, incapable of motion, cold, swollen, and pur-

plish; large vesications making their appearance, and fully formed gangrene eventually ensuing, whilst the ultimate result depends mainly on the patient's constitution and remaining strength.

Treatment of arteritis and its consequences. Where, after a scrupulous examination of the symptoms, both negative and positive, there appears a very strong presumption for the existence of inflammation of the aorta or other large internal artery, either alone, or, as pathological researches show to be so commonly the case, in combination with serious disease of a similar nature in some of the viscera to which their branches are distributed, active antiphlogistic measures are immediately to be resorted to, general and local bleeding, aperients, antimonials, and diluents, together with strict confinement to the horizontal posture and perfect quietude. If the inordinate pulsation, the fever and other distressing symptoms, be not then very speedily reduced, the exhibition of mercury so as to affect the constitution, provided there be not a decided contra-indication to its employment in the state of the patient's strength or general habit of body, together with digitalis or colchicum to keep down the heart's action, and narcotics to assuage pain, form our chief remaining resources. At a somewhat later period, or in a more chronic form of the affection, active counter-irritation by blisters, tartar-emetic ointment or croton oil should also be practised.

With a view to controlling the occasional chronic consequences of arteritis, and limiting more especially the progress of osseous deposition (which whether or no it be ever in its essence an inflammatory process, seems at least most prone to take place in parts which have been once the seat of inflammation,) as well as to retard the secondary affections dependent thereon, as aneurism, apoplexy, &c., the most rational plan of practice appears to consist in such a regulation of the diet, secretions, and excretions, as may at once keep the action of the heart moderate, obviate plethora, and subdue any tendency to sub-inflammatory action which may exist, without at the same time too much enfeebling the system. The greatest moderation in respect to fermented liquors and animal food should be enjoined, as the free indulgence in their use is well known to produce the very states which it ought to be our chief aim to avoid, and in a particular manner to augment the tendency to arthritic or calcareous deposits throughout the body. Depletory measures carried to a moderate extent should be very early had recourse to on the occurrence of inflammatory action in any part of the system, or where there is evidence of any unusual degree of vascular repletion, lest the weakened vessels should give way under the temporarily augmented action of the heart: and in general even when the patient is in his average state of health, the action of the liver and bowels as well as of the kidneys and cutaneous surface should be promoted, and the functions of the stomach which are so often, especially in gouty subjects, inadequately performed, should be corrected and strengthened. Regular but very moderate exercise in the open air is to be enjoined, together with the scrupulous avoidance of all those agencies, physical or moral, by which the circulation might be deranged or unduly accelerated.

Inflammation of the aorta is not susceptible of even probable diagnosis except when it occurs in the aorta, especially at the arch. It then offers the usual characters of inflammation; that is, a quick active pulse, often with unusual degree of vascular excitement. The local signs are throbbing in the region of the aorta, which is distinctly felt by passing the finger above the top of the sternum, and by ausculting at the bend of the front bone. The sound on percussion is not usually altered. In many cases œdema may occur as an additional sign, but it is one which is quite secondary, and in itself of little importance, because it does not occur in the majority of cases; it will, however, corroborate the other symptoms.

It is clear, therefore, that the direct signs of aortitis are not conclusive, and we are obliged to trust to the negative evidence of exclusion; and if we find that the oppression of the respiration and the excitement or uneasiness about the chest cannot be accounted for, by any obvious

disease of the heart or lungs, we are obliged to admit the probability of aortic inflammation; this is converted into certainty if the local signs be present. The diagnosis, although not absolutely certain, is less difficult than is often supposed, for there are few cases in which a sufficient number of symptoms cannot be discovered. G.

ANEURISM OF THE AORTA.

Varieties—true—false—mixed—hernial.—Comparative frequency in the sexes.—Predisposing causes.—Symptoms of aneurism of the aorta and effects on contiguous structures.—Spontaneous cure.—Aneurism of the thoracic aorta.—Aneurism of the pulmonary artery.—Aneurism of the abdominal aorta.—Treatment of aortic aneurism.

An artery may become abruptly enlarged in some parts of its course either by means of the simultaneous dilatation of all its coats from their being peculiarly weak and deficient in elasticity at the affected point, or else by the rupture of the inner and middle coats and the subsequent gradual distention of the outer or cellular one. In both these forms of aneurism the surrounding portions of the artery almost invariably present obvious marks of alteration both in colour and texture, the strength and elasticity of the vessel being very commonly remarkably impaired either by atheromatous or osseous depositions or both, and where the lesion is of recent origin, the inner membrane being sometimes of a bright reddish hue mottled with white spots.

The first of the two varieties of aneurism just mentioned constitutes the *true aneurism* of systematic writers, and may either implicate the entire circumference of the vessel in one or more points in its course, giving to it for the most part an ovoid or fusiform outline at these portions, or else, as has been observed in some very rare instances, it may be confined to one side of it, and so form a hollow lateral protuberance or pouch communicating freely with the arterial tube. The reality of this latter form of true aneurism, though doubted by Scarpa and some other distinguished pathologists, has yet in a few cases been fully ascertained by subsequent investigators, by carefully tracing all the membranes of the vessel in unbroken continuity in the parietes of the appended tumour. The tunics thus dilated have in some instances appeared of their natural thickness; but more commonly they are thickened decidedly in some spots, and attenuated in others, as becomes obvious from their unequal transparency on viewing them against the light. True aneurisms have been divided by Breschet into the sacculated, the fusiform, the cylindroid, and the varicose. The second is the most ordinary form: in the cylindroid a large extent of the artery longitudinally is implicated, as likewise in the varicose in which it becomes tortuous and knotty from the irregular dilatation of the walls of the vessels which are here peculiarly thin and flaccid.

The term *false aneurism* is applied to those more common cases alluded to above, where the inner and middle coats being either ruptured by violence, perforated by ulceration, or lacerated by the detachment of a scale of osseous matter, the outer or cellular coat becomes exposed to the distending impulse of the circulating blood, by which, as well as by the pressure of the accumulating coagulum which soon forms in the depressed surface, it is gradually dilated into a pouch which communicates by an aperture of greater or less size with the canal of the artery.

Sometimes again this laceration of the coats is consecutive, supervening upon their inordinate distention in cases of true aneurism; and here the false aneurism

surmounts the tumour previously formed by the true, and to this compound lesion the name of *mixed* or consecutive false aneurism is commonly given.

The outer coat of the artery growing gradually thicker, and being for the most part still farther strengthened and supported by the cellular membrane exterior to it becoming condensed and closely adherent to its outer surface, is frequently capable of resisting for a great length of time the internal distending force. The contained blood moreover coagulates within the sac in concentric layers, which increasing in density as they are older and more external, and becoming occasionally consolidated with the walls of the aneurism, add in a remarkable degree to its power of resistance. In true aneurism, especially when occupying the whole contour of the vessel, the formation of laminated coagula is much more rarely observed than in the false species, in consequence of the freer circulation of the blood through the cavity in the former; and in the few instances where it has been met with here, the inner membrane was usually found to have been considerably roughened either by ossific deposit or else by effused lymph, a condition peculiarly favourable to the retardation of the blood and its coagulation.

In addition to the forms of aneurism already mentioned, there is yet a rarer species which has been met with by Dupuytren and others, where the outer and middle coats being alone perforated, the inner one protrudes through them, thus forming what has been called a *hernial aneurism*.

Where an aneurism commences by the rupture of some of the coats of an artery in consequence of violent muscular exertion, there is reason to believe that the vessel must have been previously in a morbid state, either from steatomatous, osseous, or other degeneration: for the partial laceration of a sound artery in place of leading to its dilatation would rather, as Dr. Jones's experiments evince, give rise to the effusion of coagulable lymph and the obliteration of its canal. For the determination of an aneurism, however, something more than the mere morbid state of the vessels above alluded to would seem to be indispensable, for whilst aneurism is peculiarly the disease of the prime of life, these other lesions predominate more remarkably in advanced age. And again, notwithstanding the great frequency of aneurism in men as compared with women, there is no equivalent disparity in regard to the occurrence of these other preliminary morbid alterations; and finally, whilst these latter, as we have seen, for the most part occur in a symmetrical manner, that is, attack corresponding arteries of the two sides of the body about the same period, no such law is observable in respect to aneurism.*

In regard to the influence of *sex*, it would appear from a large number of cases analyzed by Mr. Hodgson, that aneurism, if all kinds be taken promiscuously, is more frequent in men than in women, in the proportion of eight to one. With regard to *internal* aneurism, however, their relative frequency in the male sex as compared with the females is by no means so disproportionate as this; probably from their origin here being commonly more independent of external injuries, violent efforts, &c.

Of the *predisposing causes*. One of the most influential, as has been remarked by Mr. Guthrie (and our own experience is quite in unison with the observation) is the inordinate use of spirituous liquors, by which apparently a sub-inflammatory condition of the coats of the vessel is induced, leading to their gradual softening and disorganization, whilst at the same time the force of the heart's contractions is inordinately increased to such a degree that the weakened artery is no longer capable of sustaining them with impunity. Enlargement of the heart often arises *pari passu* with disease in the great vessels, and the disturbance in the circulatory system is thus raised to its highest pitch. Violent blows or falls, and sudden vehement muscular efforts, have appeared in some instances indubitably the determining cause even of internal aneurism.

Symptoms. When the aneurismal tumour is so situated as to be within reach of the touch, it is generally sufficiently characterized by its expansive pulsation;

and even where it lies without the limits of immediate examination, it for the most part eventually gives rise, by its pressure on surrounding parts, to a variety of symptoms, from which its presence may often be at least very strongly suspected. Thus mechanically it may cause displacement and deranged action of various organs in its immediate neighbourhood, and at length absorption of their structure, as well as fatal hæmorrhages into their substance or cavities. When nerves are compressed by it, pains like those of neuralgia are the consequence; when it comes in contact with bone, even this dense texture yields to the wearing influence and is destroyed to a greater or less depth, a result often observed in cases of aneurism of the thoracic and abdominal aorta, in which the sternum, ribs, vertebræ, and even the shoulder-blade may be perforated by it. Cartilage, on the contrary, very often escapes, having a much greater power of resisting the influence of the constant pressure and pulsation than the harder osseous tissue, probably in consequence of the elasticity and lower degree of organization of the former; and accordingly we often find even where the vertebræ have been extensively removed, the intervertebral cartilages still almost uninjured, though actually bathed in the fluid contents of the sac, the parietes of which are themselves so prone to be absorbed under the reactive pressure of contiguous organs. The compression of the spinal cord by an aneurismal tumour, as well as by the effusion of its contents into the vertebral canal, has been known to induce sudden paralysis. An aortic aneurism may farther give rise, according to its situation, to compression or perforation of the pulmonary artery, or vena cava, or even of the cavities of the heart itself,* the thoracic duct, œsophagus, trachea, bronchi, lungs, stomach, intestines or bladder; or it may open immediately into the pleural or peritoneal sacs, or into the cellular membrane behind them. The contiguous vessels may be contracted or obliterated by the pressure, the nerves flattened, and the muscles wasted in a remarkable manner. The periosteum of the bones with which it comes in contact may be either thickened or absorbed, or even, as Andral has pointed out, become the seat of an abundant secretion of osseous matter, increasing the tumour, and restraining in a certain degree its farther growth, and retarding its rupture. The sac itself generally becomes at length the seat of increased action, and its perforation is commonly the eventual result, which in its turn leads to a hæmorrhage, for the most part at once fatal; unless, as sometimes happens, the power of resistance in the surrounding cellular membrane, condensed by the previous pressure and matted together by effused lymph, is such as to enable it to limit, at least for a time, all farther effusion of blood. In this latter case a new sack, as it were, is formed around the original one, and thus what is technically called a diffused false aneurism is formed. But diffused aneurism may also originate in a primary form, by the simultaneous rupture of all the coats of the vessel in the very first instance, without the formation of any sac, and the immediate pouring out of the blood into the lax and unaltered cellular membrane, or into one of the great serous cavities in its neighbourhood. Where the tumour bursts through the skin, or into a canal or cavity lined by a mucous membrane, these textures appear to be destroyed by a sloughing process; whereas in the case of serous membranes, the rent is effected by laceration from over-distention. The patient may, however, be cut off without the intervention of rupture or hæmorrhage, by the mere effect of the compression of the surrounding parts, the œsophagus, air-passages and lungs, the nerves, thoracic duct, or large veins, giving rise to inanition, or asphyxia, exhausting pain, or cerebral compression. Congestion and inflammation of the mucous membrane and parenchyma of the lungs are very frequent results, especially when the disease is seated in the thorax.

But aneurism happily does not always terminate fatally, whether by rupture

* In a remarkable case recorded by Beauchêne, the aneurism burst into one of the auricles.

or any of the other modes just enumerated. On the contrary, in some few instances a spontaneous cure ensues, either by the gradual condensation of the coagula, and the contraction of the walls of the sac, or by the pressure of its exterior surface upon the portion of the artery above it, the consequent obliteration of the vessel, and cessation of the distending supply of blood to the tumour, or finally by inflammation in the parietes of the cavity, either commencing there, or communicated from an abscess formed around them, and terminating either in adhesive inflammation, or in gangrene, with the formation of coagulum within the artery, and its consequent obstruction.

Aneurisms within the thorax may have their seat, not only in the ascending aorta, its arch, or descending portion, but also in the innominate and origin of the great vessels proceeding to the head and arms: abdominal aneurism in like manner is by no means confined exclusively to the aorta, having been met with also in most of the larger branches arising directly or mediately from it, as the cœliac axis, hepatic, splenic, gastro-epiploic, coronary of the stomach, spermatic, iliac, &c. The abdominal arteries, indeed, as pointed out by Professor Harrison, are peculiarly prone to the lesion in question, in consequence apparently of their great tortuosity, the weakness of their proper coats and the slowness of their cellular sheath in particular, as well as of the little support they receive from surrounding organs, and their rapidly varying degrees of distention, in connexion with the intermittent nature of the functions of the organs they supply. In their incipient stage they are for the most part unattended by any symptom by which their presence can be even suspected, and it is only when their bulk and pulsations have become notably increased that attention is at length called towards them. Their effects will obviously vary much in relation to their situation, indeed more in respect to it than to their mere magnitude: thus, for example, in a remarkable case of aneurism of the hepatic artery, detailed by Dr. Stokes, jaundice, from the compression of the biliary ducts, was a leading symptom.

The coronary arteries of the heart have in some very rare instances been discovered in a state of aneurismal dilatation; and examples of the disease in its sacculated form have been met with even within the cranium, in the internal carotid, vertebral and basilar arteries. In these latter cases the symptoms have been very obscure, such as obstinate headaches, ringing in the ear or deafness, with more or less derangement of the sensitive and intellectual faculties, and finally apoplectic attacks. It is probable, however, that the careful employment of the stethoscope would in some of these cases reveal the existence of a bellows-murmur and facilitate their diagnosis.

It is chiefly to aneurism of the aorta, as being of most frequent occurrence, and productive of very formidable and embarrassing symptoms, that we mean in the remainder of this article to direct the reader's attention. Where the disease is seated in the ascending aorta or its arch—portions of the vessel, which from their form and situation exposing them to the first concentrated impulse of the blood, are peculiarly liable to it—the morbid change appears much more commonly to commence as a true aneurism or general dilatation of the tube of the vessel in its whole circumference. Its inner coats may, however, subsequently give way, and the lesion will then present itself in the form of mixed aneurism, where a pouch of more definite outline surmounts the previous enlargement. The extent however to which dilatation of all the coats is sometimes carried without rupture is enormous, the caliber of the vessel being occasionally twice or thrice as great as natural, or even more. These enlargements being commonly partial, present in most instances the ovoid or fusiform outline already spoken of, though sometimes even the entire vessel to its very bifurcation being strikingly dilated, the cylindrical form is more or less perfectly retained.

Sacculated aneurism takes its rise more ordinarily from the front or side of the vessel or from its arch than from its back part, where it is better supported by solid parts. In extreme cases it may attain to a magnitude much greater than that of the heart itself, and if directed upwards may by its pressure distend and even

dislocate the sterno-clavicular articulation. Where planted near the root of the aorta, the rupture of the aneurism gives rise to the effusion of blood into the pericardial sac, as we should expect from the anatomical relation of the parts. The vessel in this portion of its course being destitute of the proper cellular coat, and the pericardial investment which supplies its place being comparatively little capable of distention, the dilated portion generally bursts before it has attained to any great magnitude, and often without passing through the form of either false or mixed aneurism. Sometimes again the rupture of the inner and middle coat is followed apparently within a few hours by that of the outer covering, and the case thus terminates fatally almost in its very commencement. Yet Scarpa was certainly in error in supposing this portion of the vessel altogether exempt from the sacculated form of the disease. Indubitable examples of it so situated have been recorded by Guthrie, Smith, Hanna, and others, in some of which the pouch was actually imbedded in the parietes of the heart, whilst the aperture by which it communicated with the vessel was placed either in the sinuses of the aortic valves or only a very few lines higher up. The reaction of the vessel on its contents, by which the blood receives at every systole of the artery a retrograde impulse towards the valves, has been suggested by Mr. Smith as the cause why aneurism of this part is always directed downward towards the heart; and an additional and perhaps equally influential reason may be found in the form of the enveloping pericardial sac, which from its pyriform shape leaves much more facility for the descent than for the ascent of the tumour.

There is a very rare form of the disease, generally described under the name of the "*dissecting aneurism* of the aorta," in which the blood is found extensively diffused between the middle and outer coats, which are thus separated occasionally for the length of several inches. In such cases it is generally found on examination that the blood has made its way out of the canal through a large fissure embracing a considerable portion of the circumference of the vessel, and generally either at right angles to its axis, or very irregular, so as to allow the impelled fluid to play at once upon a large extent of the connecting cellular membrane and rapidly overcome its resistance: whereas, in the sacculated form the dilatation seems to commence on a much smaller scale, to proceed in a more gradual manner by the simultaneous distention and growth of the external coat, whilst the connecting cellular tissue having thus time to become consolidated, resists more effectually the insinuation of the blood between the adjacent tunics. Laennec mentions an instance of dissecting aneurism where the blood had forced its way along the greater part of the extent of the aorta. The late Mr. Shekelton has described a still more remarkable variety of the disease, where the blood after thus detaching the two inner coats from the outer for some distance, re-entered the aorta again lower down; thus passing along for a certain way in an adventitious collateral canal, whilst the original channel was narrowed or obliterated by the pressure; and Mr. Smith speaks of a somewhat similar case where the additional complication of a subsequent rupture into the pericardium co-existed.

An interesting case is admirably described by Dr. Pennock in the *American Journal*, illustrated by one of the most perfectly executed anatomical engravings which have ever been published. G.

Aneurism of the Thoracic Aorta.

The *general signs* of this affection are commonly very obscure, many of them being almost identical with those of disease of the heart, in complication with which, moreover, as we have seen, it very often co-exists. The chief of these are such as originate in obstacle to the circulation and respiration—as palpitation, tendency to syncope, cough, dyspnoea occasionally in the form of asthmatic paroxysms, preference for the sitting posture, with the body bent forwards or a little to one side, so as to relax the parietes of the chest, hæmoptysis, frightful dreams

and other evidence of cerebral congestion, together with a livid or otherwise unnatural complexion, and finally dropsy of the serous cavities and cellular membrane of the extremities. But indefinite as these general symptoms are, the difficulty is still farther increased by many of them being often moreover altogether absent, very slight cough and almost unnoticed embarrassment of the respiration having in several cases alone preceded the sudden and unexpected fatal event.

Of the symptoms which are somewhat more characteristic, though obviously not absolutely peculiar to this lesion, are a sense of oppression, tightness, or wandering pain in the chest, tenderness on pressure in some of the dorsal vertebræ, together with pain of a boring kind in the same situation, and occasionally lancinating thence through the chest and towards the neck, shoulder, and arm, along with numbness, a creeping sensation and loss of power in the latter, and swelling both there and in the corresponding side of the thorax—effects of the pressure of the aneurismal sac on the brachial plexus, sub-clavian artery, and vein. Weakness or total absence of the pulse at one wrist, more commonly the left, is not unfrequently observed, together with difficulty and pain in the act of swallowing, from the pressure on the œsophagus, the latter being most apt to occur where the aneurism is seated in the arch or descending aorta; a whispering or croaking voice, together with a deep-seated wheeze or a sibilant character of the respiration from narrowing of the trachea, retraction of the larynx, and compression of the recurrent nerves.* There is often, likewise, marked impairment of the vesi-

* *Resilience of the pulse*, produced by the resilience of the aneurismal tumour after each beat of the heart, has been pointed out by Dr. Billing (*Med. Gazette*, December 14, 1833,) as a sign by which aneurism in the chest may be discovered in its incipient state. While the resilience is as yet slight it requires, he adds, some practice to feel it, and the finger must be kept with a light elastic pressure on the artery at the wrist. It is said to be perceptibly different from the double pulse sometimes connected with valvular disease. Its presence in the arteries, both of the upper and lower extremities simultaneously, might, we apprehend, become an index of aneurism being seated near the commencement of the aorta or in its arch; whereas, if it were observed only in the pulse of arteries coming off from the aorta in a subsequent portion of its course, it might render it probable that the disease had its seat somewhat lower down.

We have already alluded to Dr. Billing's early advocacy of the dependence of *both sounds* of the heart exclusively on *valvular tension*, but are induced to recur to the subject here from having just noticed a new and able statement of his arguments in favour of this view, in the *Medical Gazette* for April 3, 1840. "I contend," he says (in opposition to Dr. Hope and others) "that the first sound as well as the second is entirely valvular, and deny that any part of it depends on muscular noise for when there is simple hypertrophy (increase of muscle and muscular action) there is diminution of sound, although more of the condition necessary to 'bruit musculaire,' . . . it is the valves being enroached upon, and their having less blood to stretch them, which prevents their producing the usual sound. Again, where there is moderate hypertrophy with proportional dilatation, there is not appreciable increase of sound . . . as the valves are in their usual relative condition. Again, where the heart is enormously enlarged by hypertrophy and dilatation, in which cases, there ought to be enormous first sound, if 'bruit musculaire' were a cause, there is none, or scarcely any, because the openings are so dilated that the valves cannot act." As to the difference of character of the first and second sound, he says, "I have accounted for the difference of sound by the difference of shape of the auriculo-ventricular valves; their attachments are different; they are set in stronger rims: the sigmoid valves are merely attached in a tube as it were, whereas the auriculo-ventricular have a firmer and different attachment to the parietes of the ventricle, which being in systole at the time of tension, altogether a flatter and longer tone is produced. The second sound being admitted to depend on valvular tension, respect for Newton's doctrine of simplicity of causation should, he thinks, prepare us to recognise a similar origin of the first. He farther shows that those who suppose the valvular explanation of even the second sound to have originated with Dr. Elliott, or to have been clearly advocated by him, are in error. Dr. Bryan also supported

cular dilatation in one lung from the obstruction of the corresponding bronchus, but which may occasionally be momentarily overcome by making a very deep and forcible inspiration, whilst in the opposite lung the breathing may be of a decidedly puerile character. To the importance of such a comparative estimate of the state of the respiratory murmur on the two sides of the chest in the recognition of thoracic tumours, attention has been particularly drawn by Dr. Stokes and Dr. Greene in their valuable contributions to the pathology and diagnosis of aortic aneurism. Sometimes each inspiration has at the affected part a peculiar puffing character, as if the result of several very short and rapidly successive respiratory efforts, but really depending on the intermittent compression of the air-passages by the pulsations of the tumour. The face is often remarkably swollen, in consequence of the compression of the cava descendens and other cervical veins; and from the same cause, there frequently exists, as pointed out by Dr. Stokes, an unnatural thickness around the root of the neck, which he supposes to consist rather in a general turgor of these vessels than on serous effusion.

With regard to the *physical signs*, it may be remarked, that as the disease progresses, there may usually be detected an unnatural dulness on percussion in the upper part of the chest, and most frequently just below the left sterno-clavicular articulation, along with an abnormal pulsation of an expansive character in the same situation, or else between the cartilages of the ribs, or beneath the sternum, or just behind the upper edge of the same bone. It is, however, occasionally only to be felt on thrusting the fingers down as deep as possible at the root of the neck, whilst the sterno-mastoid muscles are at the same time relaxed by bending the head forwards. The percussion of the sternum is in some instances productive of pain. If the aneurism arise from the ascending aorta, it generally presents on the right side of the sternum; but if seated on the arch, or innominata, it usually makes its appearance at the upper part of this bone, and towards the inner ends of the clavicles.

Auscultation generally reveals a bellows-murmur of a peculiarly loud, rough and abrupt character, above the clavicles, and perceptible also in the carotids and sub-clavians, and sometimes for a short way along the back; whilst beneath the sternum it is of a more superficial or whizzing character, and is commonly inaudible in the region of the heart.

From the obstructed state of the pulmonary circulation and the interference with the nervous functions of the lungs, congestion of the pulmonary tissue and pain is frequently produced, as well as extensive bronchial rales. The expectoration is sometimes bloody, and even sympathetic hæmatemesis occasionally takes place. The cough which so commonly accompanies these cases, is apt to come on in suffocative paroxysms—in some instances it has a ringing croupy character, a sense of retraction of the trachea and larynx being produced by the tumour, and so much distress of breathing as to have given rise to the erroneous impression of the existence of an acute or chronic laryngitis in its final stage, and

the valvular theory of the sound, but not so early as Dr. Billing. (See *Lancet*, January, 1833.)

Whilst we readily admit that there is much force in several of the above arguments, and that they lead us to doubt whether we have not somewhat under-stated, in the text, the influence of valvular tension in augmenting and modifying the first sound of the heart, we confess we still find a difficulty in reconciling the very prolonged character of this sound with simple tension of the auriculo-ventricular valves, or in getting rid of the fact, alluded to at p. 262, of the continuance of this sound with a certain degree of strength, after the ventricles are emptied of their blood, and these valves otherwise completely ineapacitated for action. Nor is extreme thickening of the muscular parietes of the heart, the condition which we should *à priori* expect to be the most favourable to intensity or rapidity of contraction, and sonorous vibration. It is, we think, in the thinner and more expanded muscles, that "bruit musculaire" has been most generally audible.—AUTHOR.

even to the performance of the operation of tracheotomy. The absence of pain in the larynx on pressure, and the circumstance of this part not being moved up and down so rapidly and extensively, should, as Mr. Porter has remarked, aid us in avoiding so gross an error.

Though the only *certain* evidence of the existence of aneurism is, to use the words of Dr. Hope, a tumour presenting externally and offering an expansive as well as a heaving pulsation synchronous with the action of the heart, still, when a large number of the signs and symptoms enumerated above co-exist, they will even without such pulsation render its presence highly probable, as it certainly is by far their most frequent source. It is plain, however, that some of them may be produced by any tumour of a certain bulk, so situated as to compress the same organs as usually suffer from the proximity of an aneurism. Thus, when a large tumour presses on the heart, especially if in an hypertrophic state, or on the aorta of great vessels arising from it, it may transmit their pulsations to the surface, and so far simulate aneurism; and the resemblance will be still closer where the œsophagus or air-passages are simultaneously implicated; but on the other hand, the murmur, if any, will be of a much softer kind when it originates in mere compression of the vessels. It has been suggested that the diagnosis may be aided occasionally by observing the effects of exercise on the phenomena in question; for it seems probable, that in the case of aneurism they will become more prominent when the sac is most fully distended: hence in doubtful cases we should direct the patient to take a few rapid strides up and down the room in the interval of our examinations, and notice the changes so effected on the breathing, &c. Before forming our final judgment, all the possible causes of dyspnoea should be passed in review, such, for instance, as an hysterical habit, flatulence in the stomach or intestines, tumours of various kinds, as scrofulous glands, &c., pressing on the trachea or lungs, or in the nerves which supply these organs or the diaphragm. We have known the most obstinate paroxysms of periodic asthma, ascribed during life to organic disease of the circulatory system, to have their real source in an osseous tumour not larger than a pea imbedded in the substance of the phrenic nerve. In respect to dysphagia, the knowledge of its occasional connexion with aneurismal compression shows the necessity of great circumspection in all dubious cases where the employment of the probang is meditated.

Of the signs of thoracic aneurism, one of the most characteristic, after the expansive pulsation above alluded to, is doubtless the bellows-murmur or harsh rasping sound which is of a much more constant, abrupt and rough character, as well as more localized or limited in its site, than that connected with anæmia and nervous excitement, and where present (for it is by no means an inevitable accompaniment of the disease) serves often to disclose the precise situation of the tumour. It is louder than most cardiac murmurs, and the depth and hollowness of the tone is generally greater above the clavicles than below, which has been ascribed to its being reverberated through the chest before it reaches the ear. A vibratory thrill also is sometimes very perceptible to the hand applied over against the aneurism either in the upper part and front of the chest or in the back; but this is rarely the case till it has attained to a very considerable size, and either spread beyond the edge of the sternum, or caused the absorption of the corresponding portion of this bone or of the vertebræ and adjacent portion of the ribs. In dilatation of the arch of the aorta purring tremor *above* the clavicles is, according to Dr. Hope, an almost constant, and therefore very valuable sign. In the sacculated variety it is much less frequent. Where the parietes of the sac have become thick and unyielding, and lined internally with dense coagula, they will obviously be so much the less suited for generating vibrations calculated to affect either the hand or ear. "In all cases of dilatation, and the majority of sacculated aneurisms, the sound is loudest above the clavicles, even though the impulse be stronger below." In the sacculated kind it is in some few instances louder on the side of the neck, opposite to that where the tumour exists; which is ascribable either to additional disease in the lining of the artery at a point beyond the

aneurism, or, in other cases, to the remoteness of the mouth of the sac from the side which the great mass of the tumour occupies.

It was at one time supposed that the abnormal pulsation of aneurism might be distinguished with certainty from that connected with an enlarged heart, by the former being accompanied by only a single sound audible in the upper part of the chest, of an abrupt hoarse character, instead of having the gradual swell and fall of that produced by the heart, and by its diminishing in intensity as we descend towards the cardiac region. To the sufficiency of this latter part of the attempted diagnosis Laennec objected, apprehending that the second sound of the heart, especially when the organ is at all dilated, may often be sufficiently loud to be heard in embarrassing connexion with the single sound of the aneurism. Dr. Hope, on the other hand, in the first edition of his work, expressed his belief that this difficulty may always be got over by attention to the peculiar character of the aneurismal sound, to the circumstance of its being often louder above than below the clavicles,* and finally and chiefly to the assumed fact of the second sound, when audible, always increasing in intensity as we carry the stethoscope from the top of the sternum towards the heart, whilst the other sound becomes simultaneously feebler. As to the correctness of this supposed fact, there is, however, much room for doubt; for various recent observers have on the contrary ascertained that the aneurismal pulsation is occasionally double, and accompanied by a double sound of such a kind that the second part is absolutely louder near the top of the sternum than that heard opposite the heart itself.† This has been ascribed, and in some cases apparently justly, to the contact of the tumour with the heart, and the more vivid transmission of the sounds of the latter through the condensed walls of the sac than through the flaccid heart just then in its diastole. But in other instances, again, the heart and aneurism not being in close connexion, this explanation fails, and we are then obliged to rest in that proposed by Dr. C. Williams, viz., that the sound is transmitted upwards from the semi-lunar valves, through the tense column of arterial blood. From the contiguity of the arch of the aorta and great vessels arising from it to the top of the sternum, this valvular sound is here generally actually louder, both in health and disease, than a little way lower down and nearer the heart, where the spongy tissue of the lung intervenes and deadens it. In the recent edition of his treatise Dr. Hope still maintains that aneurismal pulsation, though double, may readily be distinguished from the beating of the heart, inasmuch as the first aneurismal sound will be decidedly a morbid murmur, and therefore very different in character from the first sound of the heart. If there be no valvular disease this

* The diagnosis of aneurism of the aorta is like that of inflammation, deduced as much from the absence of signs of other diseases as from the positive symptoms of the dilatation of the artery. Indeed these are often so obscure, that individuals placed near the patient are unwilling to believe that with the general characters of good health, he should be labouring under a serious disorder of an organ essential to life. The positive signs of most value, are a persistent throbbing behind the sternum, which raises the finger with a momentum not unlike that of a hypertrophied heart, the pulsation being in most cases increased by exercise: if the tumour be at all large, the percussion becomes dull below the first bone of the sternum, and even in the earlier stages there is heard a very distinct double sawing sound.

We do not believe that this double sound is owing in most cases to actual disease of the valves of the heart, and that the column of blood in the artery is merely a conductor; on the contrary, it seems to arise from a reflux of blood through a cavity which breaks up the continuity of the regular current; and in some of these cases the proof of it is, that the natural valvular sound may still be heard at the region of the semi-lunar valves.

The secondary symptoms, such as dyspnoea, oppression, and neuralgic pains, or even paralysis from the pressure of the tumour upon the bodies of the vertebrae, are of more value, if the diagnosis of the signs of disease of the heart itself are wanting.

† Williams, Stokes, Ferguson, &c.

G.

murmur will become progressively weaker as we descend towards the lower part of the heart; whereas the first cardiac sound becomes loudest here. But if the first sound of the heart, in consequence of co-existing valvular disease, be attended with a murmur, this must depend either on auricular regurgitation, or else on obstructive disease of the sigmoid valves. The first of these alternatives may be confidently rejected when the murmur is loud and distinct, at any part above the third rib. But if the murmur be loud and near-sounding at about an inch above the apex of the heart, a situation in which the aneurismal murmur would be nearly inaudible, we may feel certain on the other hand that such reflux actually takes place.

If the concomitant murmur be a semi-lunar obstructive one, the diagnosis is more difficult, but still generally practicable, the valvular murmur will be propagated, as we have already seen, two inches or more along the course of the vessel, whether the aorta or pulmonary artery, in which it originates—but when considerably louder, and in a higher key, at two inches or more above the valves than opposite to them, we may conclude that it results from the roughened coats, dilatation or aneurism of the vessel. It being thus possible, continues Dr. Hope, to distinguish with certainty the first sound of an aneurism from the first sound of the heart, whether natural or with murmur, the presence or absence of the second sound of the heart or an aneurismal tumour is unimportant; “yet even this sound can generally be traced up, with a progressive increase of intensity, either to its immediate source, the semi-lunar valves, or to the line of the aorta and pulmonary artery, along which and the sternum it is propagated as far as the clavicles.” “The second sound of an aneurism is occasionally attended with a feeble murmur arising from the expulsion of a portion of its blood by the elastic contraction of its walls during the ventricular diastole.” (p. 443.) But this is easily distinguishable from the murmur of semi-lunar regurgitation, by the latter being audible along the course of the ventricles and by its being exceedingly prolonged, namely, through the whole diastole and period of repose. A diastolic mitral murmur would be too feeble to be heard in the situation of the aneurism.

Dilatation of the aorta. The loudest and hoarsest *aneurismal sound* is that caused by dilatation, and it is the more grating the rougher the interior of the vessel. “Where the dilatation is confined to the ascending aorta, the sound, impulse, and purring tremor above the clavicles are stronger on the right than on the left side; and the sound along the mesial part of the sternum, the tract of the ascending aorta, is often superficial, and of a whizzing character.” *Purring tremor* is greater in simple dilatation than in sacculated aneurism, inasmuch as it is particularly favourable to the production of eddying currents; it is, moreover, permanent, restricted to the space above and between the sternal ends of the clavicles, and always accompanied by the peculiarly hoarse murmur already described; whereas the thrill occasionally connected with anæmia is feebler, occurs when the heart’s action is excited, pervades the adjoining arteries, and is accompanied by a murmur of a soft character, as well as by a venous hum in the jugulars. In dilatation *pulsation* exists above the sternal ends of the clavicles only, and on both sides simultaneously, though if the enlargement be confined to the ascending aorta, it is stronger on the right side than on the left.

Sacculated aneurism of the thoracic aorta has for its physical signs. 1. “A pulsation, both above and below the clavicles, but usually stronger below. If the tumour occupy the ascending aorta its impulse is most perceptible on and to the right of the sternum, often with a visible intumescence of the parts. If it is seated in the commencement of the descent, the pulsation and swelling incline to the left side.” 2. An abrupt murmur similar to that described under dilatation, only somewhat feebler, and less rasping. 3. A purring tremor above the clavicles, but very rarely below, unless erosion of the bones has already occurred. (Hope, 3d ed., pp. 441 to 456.)

To what we have already said on the diagnosis of other affections from thoracic aneurism, we may here add from Dr. Hope, that “*pulsating glands or other tumours* in the anterior mediastinum are not attended with the aneurismal sound,

or only in a slight degree; no impulse and tremor are felt above the clavicles; and symptoms of a disturbed circulation either do not exist at all, or do not correspond in severity with the magnitude of the apparent disease. Enlarged glands or other tumours above the clavicles, receiving pulsation from a subjacent artery, rarely occasion sound; if any exist it is a feeble whizzing, such as is produced by compressing an artery with the edge of the stethoscope. Both it and the pulsation are confined to the side affected. If the tumour can be grasped it will be felt not to dilate laterally during the ventricular contraction; and if it can be raised from the subjacent artery, its beating and whiff will cease entirely. An *enlarged heart* produces an impulse which is strongest at the apex, and decreases progressively on receding from it; the beating of an aneurism is stronger on the tumour than at some point intermediate between it and the apex of the heart; and in most instances it is stronger than even the beating of the heart itself. Hence an aneurism distinctly conveys the impression of there being two centres of motion, the tumour and the heart. Finally, the ventricular contraction of an enlarged heart produces an ordinary sound, but is not attended with aneurismal murmur or pulsation above the clavicles." Varix of the jugular veins is distinguishable by the absence of sound and impulse, and by the compressibility of the tumour: but it is to be remembered that their swollen condition may depend on the pressure of an aneurism against the descending vena cava, as well as that of any other tumour.

Aneurisms of the innominata, of the root of the carotid, and of the sub-clavian, where they have already attained to a considerable magnitude, are scarcely to be distinguished from those of the arch of the aorta. It has indeed been suggested, that from the circumstance of their producing impulse and sound only on their own side of the chest and root of the neck, they may be discriminated from the latter; but we apprehend that in practice this will often be found a very insufficient criterion, especially in respect to distinguishing them from aneurism of the commencement of the descending aorta and adjacent portion of the arch. Their true nature may, however, frequently be recognised with some confidence from their accompanying impulse, sounds, and thrill, being peculiarly superficial and distinct. The morbid murmur of sub-clavian and carotid aneurisms resembles, as Dr. Hope remarks, the blast of a small hand-bellows, rather than the hoarseness of a forge-bellows.

Aneurism of the *descending thoracic aorta* is generally much more difficult of recognition than that seated higher up, as there rarely exists any external pulsation indicative of its presence. The symptoms which occasionally point to it are pain in the corresponding portion of the back, a thrilling tremor imparted to the hand firmly applied there, and a hoarse single bellows murmur, much stronger in this situation than in front over the heart, together with impaired respiration in a portion of the lung, without any other evidence of pulmonary disease, as likewise dysphagia seated low down in the chest. The absence of such symptoms as are peculiarly indicative of aneurism of the arch or commencing aorta, as numbness of the arm, resiliency of the pulse, unequal pulsation at the two wrists, swelling at the root of the neck, stridulous respiration, may aid us still farther in localizing the disease in the descending portion of the vessel. A strong double jogging impulse, in the absence of adhesion of the pericardium, and of displacement of the heart to the front of the spine, is proposed by Dr. Hope as a new sign of an aneurism of the descending aorta, or other tumour situated behind the heart, so as to push it forward. When the descending aorta is the seat of the aneurismal tumour, the left lung is the most likely to suffer from its pressure, and it is into the pleura of this side that fatal hæmorrhage is most apt to take place.

Dilatation of the Pulmonary Artery.

This is very rare. Its presence, according to Dr. Hope, may be ascertained when very considerable, by the existence of an abnormal pulsation, and purring

tremor between the cartilages of the second and third ribs of the left side, together with an extremely loud, superficial, and harsh sawing sound, decreasing downwards towards the heart, and at the same time *not appreciable above the clavicles*; and the evidence will be greatly strengthened if there exist an obvious prominence in the above-mentioned situation.

A sacculated aneurism of the ascending aorta, if so large as to reach to the left side of the sternum, would cause so extensive a dulness, or so great an obvious tumour, that it could not readily be mistaken for the disease in question. Besides, in the former there would exist pulsation, murmur or tremor above the *right* clavicle also, or on the *right* side of the sternum, or above both clavicles.

Aneurism of the Abdominal Aorta.

The aorta, in its passage through the abdomen, being, as well as its branches, closely embraced by innumerable nervous filaments proceeding from the solar plexus, the irregular or sacculated dilatation of any portion of the vessel is generally productive of a set of very painful and often extremely embarrassing symptoms, which vary remarkably in their site and character in proportion as the tumour increases in bulk and comes to press on new parts. There is scarcely any organ within this cavity, which has not, at one time or other, presented from this cause notable derangement either of a nervous or functional, or of an inflammatory character: and the concatenation of disorders has sometimes been so intricate, that we have known many of the first practitioners in Europe to have been consulted in succession without any of them even surmising the real source of the complicated evils. Thus a case of this kind has been alternately viewed as an instance of inveterate rheumatism of the lumbar and abdominal muscles,—as neuralgia of the sympathetic and associated nerves,—as aggravated dyspepsia, obstinate constipation, and violent colic, or even stricture of the rectum—as hepatic or renal affection, diseased spine, or psoas abscess.*

From all this it is apparent that the *general symptoms* of abdominal aneurism are, especially when taken separately, in the highest degree fallacious and perplexing. There is often intense pain, though generally of an intermittent character, in the loins, lancinating occasionally upwards and forwards into the hypochondriac regions and abdominal muscles, and downwards into the testicles and lower extremities, the latter being at times cramped or convulsed, or at length even completely paralyzed, as are likewise the bladder and rectum, where the tumour by its pressure comes to interfere with the functions of the spinal cord; and under the same circumstances even perfectly formed tetanic symptoms (opisthotonos and emprosthotonos) have been known to occur.

Where the sac is so placed as to be closely bound down by the crura of the diaphragm, acute pain is often felt in the attachments of this muscle all round, especially if the enlargement takes place in an upward direction; and as it often by its bulk greatly impedes its motions, and sometimes, moreover, bursts at length into the pleuræ, it is not extraordinary that severe pulmonary distress should occasionally be complained of, particularly in the latter stages of the disease. The liver is sometimes thrust down by it below the margin of the ribs, and many of the symptoms of even an acute hepatitis have been occasionally induced. One of the commonest features is vehement colic not unlike that produced by lead, of frequent recurrence, and aggravated by the constipation and flatulence so frequently present in this affection, as also by particular postures; and it has been ascribed, together with the occasional occurrence of nausea and vomiting, and pain and

* See, in confirmation of this, the very interesting case of Mr. Mayne, by Dr. Beatty, in the fifth volume of the *Dublin Hospital Reports*, and various recent ones in other medical journals.—AUTHOR.

tenderness at the pit of the stomach, to sympathy of the alimentary canal with the injured coats of the artery, but with still greater probability to the pressure made by the tumour on the nerves of organic life. The pulse is unaffected throughout a great part of the duration of the disease, and the appetite in some cases very good, whilst the effects of indulging it are by no means productive of the rapidly injurious consequences which are sure to ensue where the same abdominal organs are the seat of idiopathic disorder.

Of the *physical signs*, the most characteristic, where it can be detected, is doubtless the existence of a fixed pulsating and somewhat compressible tumour in the course of the aorta, which can sometimes be very satisfactorily ascertained through the abdominal parietes, and even its outline traced out by the firm application of the stethoscope or points of the fingers over its confines, and this especially when the enlargement is seated in the front or sides of the vessel, and not so high up as to be tightly tied down by the diaphragm. In making such an examination, the patient should be in the recumbent posture, with the knees and chest raised, so as fully to relax the abdominal parietes, and a period selected at which the stomach may be empty, and the bowels have been well cleared out by an aperient, especially if there is reason to apprehend the presence of scybala in the intestinal canal. It has been farther suggested by M. Piorry, that by pressing firmly with one hand on the abdomen, and the other at the same time on the spine, we may form a tolerable guess as to whether there is a greater thickness of solid parts than natural, and still more accurately if we have recourse to the callipers used by midwifery practitioners. Percussion may also at times afford us material aid, by revealing a preternatural degree of dulness where the tumour is large.

By auscultation a bellows murmur of a brief and generally of a rough character is very commonly to be recognised in the epigastric region or lower down in the abdomen, and sometimes also in the corresponding portion of the spinal column: it may be conveyed downwards for some distance below the point where it originates, but rarely extends upward, so as to give rise to its being confounded with morbid sounds in the heart. It is sometimes accompanied here, as in other situations, with a vibratory thrill, perceivable on the firm application of the hand over the part. This sensation becomes most evident in those cases where the tumour has already caused the destruction of a portion of the vertebræ and heads of the adjacent ribs, and begun to form a distinct prominence in the dorsal or lumbar regions.

In some rare instances the pulsation of the tumour has been double, a phenomenon generally ascribable to its spreading upwards into a close contiguity with the heart, and the consequent transmission of the action of the latter.

In respect to the bellows murmur as connected with aneurism of the abdominal aorta, Dr. Corrigan has observed, that in some cases where it is altogether imperceptible in the erect posture, it may be rendered quite distinct by causing the patient to assume the horizontal one,—a fact which he explains in conformity with his views of the mode of generation of this sound; namely, by the reduction of the hydrostatic pressure within the sac, the consequent relaxation of its parietes, and greater facility of vibration under the influence of the current-like motion of the blood simultaneously produced. According to Dr. Graves, by elevating the pelvis, and depressing the thorax, the intensity of this phenomenon, whether the pulsation be aneurismal or merely nervous, may be still farther increased.

In regard to *diagnosis*, it must be recollected that abdominal pulsation may originate, as already intimated, under very dissimilar conditions, nervous, inflammatory, and obstructive, quite independent of aneurismal disease. When either the pulsation or the accompanying bellows murmur depend on scirrhus or other tumours of the viscera, stomach, pancreas, liver, &c., on the distention of the intestines by hardened fæces, or conglomerated masses of worms, the impulse will be of a less truly expansive character, as ascertained by the lateral application of the hand or stethoscope, and the sound of a less hoarse and grating kind. In case of the existence of fungus hæmatodes or other very malignant form of disease, the

general aspect of the patient, the rapid wasting, and perhaps also the greater constancy of the pain in respect to site and duration, may afford useful aid in the formation of the diagnosis. Where the augmented pulsation is connected with the pressure and conducting power of a serous effusion in the peritoneal sac, the sensation of fluctuation, on striking the parietes, will serve to elucidate the true nature of the case. Though organic disease of the heart very commonly co-exists with aortic aneurism, yet in some instances it is only simulated, the organ being displaced, and its action deranged in a very remarkable degree, by the pressure of the tumour. Aneurisms of the branches of the aorta, as the cœliac axis, mesenteric arteries, &c. may generally be distinguished in their earlier stages from those of the aorta by their greater mobility.

When an aneurism has burst into the cellular membrane behind the peritoneum, an accident which has sometimes been survived for a very considerable period, pulsating tumours will manifest themselves in various situations, in the lumbar, iliac, or hypochondriac regions, with a corresponding increase of dulness on percussion, and a diminution of the previously existing circumscribed enlargement of the aorta. The magnitude to which ventral aneurisms sometimes attain before becoming ruptured is enormous: thus in a case recently detailed by Sir David Dickson in the *Medico-chirurgical Transactions*, the tumour which originated by a kind of neck from the back of the aorta about two inches above the cœliac axis, expanded over the whole abdomen with the exception of the cæcal region, and protruded in a conical form under Poupart's ligament, where it might have been mistaken for an aneurism of the external iliac artery.

Treatment of aortic aneurism. The two principal indications to be held steadily in view in the management of this affection, as tending in all cases materially to retard, and in some even to arrest its progress, are—1st, to keep the action of the heart within moderate bounds—and 2dly, to reduce the quantity of circulating fluid without impoverishing its quality. It is under these conditions that the distending impulse within the tumour being restrained, whilst the capacity of the blood to coagulate and form firm and adherent fibrinous concretions is unimpaired, the current through the sac becomes limited, the parietes strengthened, and the best chance afforded for the filling up of its cavity with organized matter.

Quiétude of mind and body, or rather the avoidance of all fatiguing exercise of either—the enjoyment of a pure air and easy gestation at frequent short intervals, so as to support the general tone of the system and promote the due performance of the secretory and excretory functions—a dry and moderate but not a very low diet—and attention to the state of the alvine evacuations, which are so often irregular (and not without great aggravation of many of the symptoms, especially where the aneurism is situated within the abdomen,)—are points of great importance and very general application.

Where there is plethora of the system at large, congestion or inflammation in the lungs or any other important organ, the early but moderate employment of venesection is for the most part demanded, and either this or the application of leeches over the seat of the disease, together with the exhibition of digitalis, should be had recourse to where the aneurismal sac or the parts on which it bears become the temporary seat of increased action and augmented pain; and opiates and other anodyne remedies externally or internally employed, together with counter-irritants, will often prove valuable auxiliaries. With regard to leeching, however, there is a caution necessary—namely, not to practice it in those cases where the tumour has already advanced so near the surface that there is great tenderness along with redness or other discolouration of the skin, which has now become thinned and coherent, lest the irritation of the leech-bites might accelerate the sloughing process.

As to the propriety of enforcing the rigid plan of treatment practised by Val-salva and Albertini, which has already been alluded to in the section on hypertrophy of the heart, there has long been some difference of opinion. The voice of the more judicious part of the profession and of nearly all those who have of late

devoted their attention more particularly to the treatment of cases of internal aneurism on a large scale, is we think at present decidedly adverse to its employment, except perhaps in individuals of a very robust constitution. We do not mean at the same time to insinuate that it is equally rarely applicable as an adjunct in the treatment of aneurism of the extremities, or in such situations as are within the reach of local applications; as ice, evaporating lotions, compression, and such other means as are daily employed by surgeons for reducing the size of pulsatory tumours and promoting the coagulation and organization of their contents. In aneurisms of the aorta, however, an extremely lowering system is generally found to do more harm than good, by inducing arterial reaction or a nervous and irritable state of the constitution incompatible with healthy reparatory action in any part of the system, by weakening the coats of the artery as well as by giving rise to a thin watery condition of the blood by which even the existing laminated concretions, so far from being augmented and consolidated by plastic lymph, are apt to get detached and washed away, one great bulwark against fatal rupture being thus speedily removed. In those rarer cases where the state of the general health and strength and the power of maintaining a rich state of the blood, almost in spite of an extenuating diet and reiterated venesection, are such as to induce the practitioner to recommend, and the patient to submit to the full employment of the Italian method, strict confinement to the horizontal posture and the most perfect rest must be simultaneously enjoined, along with the unwavering perseverance for months in order to give this treatment any chance of success. Half measures here are worse than nugatory, as they would only impair the general health without holding out any rational prospect of beneficially modifying the local disease; whilst their precipitate renunciation after having been unnecessarily employed for a time, would soon give rise to its turn in the additional inconvenience of an artificially created plethora. Of the numerous cases supposed to have been cured in former days by Valsalva's treatment, not a few were probably altogether exempt from organic disease, the method of diagnosis being then very imperfect.

With a view to augmenting the coagulability of the blood the super-acetate of lead in half grain or grain doses thrice a-day, guarded if requisite with opium, has been occasionally employed in Germany and France, as well as in this country, with some appearance of benefit. Its effects must however be carefully watched, and any irritation of the gastro-intestinal mucous membrane subdued by the exhibition of oleaginous purgatives and other remedies appropriate to cases of poisoning by lead.

It appears incontestable, from several cases recently published by the most competent observers, that a tonic treatment, along with a reparative and rather generous diet, is in many instances much more applicable than the opposite; it has occasionally, indeed, been productive of the most marked and immediate relief of the intense neuralgic suffering, the colics, muscular pains, &c., by which abdominal aneurisms are so often accompanied; whilst a very lowering plan has seemed in the same individuals as decidedly injurious, both in respect to the severity of the symptoms and the progress of the disease towards a fatal result.*

In advanced and aggravated cases of thoracic aneurism, the paroxysms of dyspnoea, the harassing cough and dropsical symptoms which at length set in and add so heavily to the patient's sufferings, may often be for a time relieved by the moderate exhibition of mercury combined, according to circumstances, either with digitalis, squills, ipecacuanha, or sedatives, together with the occasional though very sparing employment of the lancet in moments of peculiar exasperation, especially when connected with inflammatory action. The use of purgatives as well as of diuretics is calculated to procure considerable temporary alleviation under some of the above circumstances.

The frequent co-existence of disease of the heart, often of a yet more hopeless

* See Dr. Beatty's case, before alluded to; Dr. Frazer, cited by Dr. Stokes in the fifteenth number of the *Dublin Journal of Medical Science*; Dr. Graves, &c.—AUTHOR.

nature than that of the aorta itself, is never to be lost sight of in the regulation of our treatment, any more than in the formation of our prognosis. But though this complication may prevent us from entertaining any the most remote hopes of curing the disease, still much may be done to render the remnant of existence more endurable, chiefly by the exhibition of such medicines as tend to moderate and regulate the action of the heart; and amongst the most influential of these palliatives, according to the recent clinical researches of Dr. Lombard of Geneva, and in conformity with previous experience, are to be reckoned assafœtida, camphor, and polygala seneka—remedies which, though peculiarly suited to those cases of palpitation or excessive action of the heart connected with nervous excitability, or dilatation and feebleness of the organ, are yet not inappropriate, even in those where the heart, though hypertrophied, has to struggle with an almost overpowering obstruction. To the debilitating system he is no less averse than was the late M. Dupuytren, and are most of the best recent British and American authorities.

DISEASES OF VEINS.

General observations on diseases of the veins and their functional derangement.

DISEASES of the veins were long much overlooked; but have of late years, or since John Hunter drew particular attention to them, been investigated with great success by a host of distinguished pathologists.* The lesions to which they are subject differ very considerably in many respects from those of arteries, in consequence of their dissimilarity of functions and structure. Thus there is nothing in their composition analogous to the middle or yellow fibrous and elastic coat of the last-named vessels, with its marked tendency to disease and destruction from the deposition of steatomatous and osseous particles; and as all the venous coats are of a nearly equally yielding nature, when dilatation ensues it assumes neither the form nor local magnitude of the ordinary or sacculated species of arterial aneurism, but rather that of a general enlargement and flexuous elongation of the trunk of the vessel in a considerable portion of its course as well as of its ramifications. The veins, moreover, are not exposed to the direct or pulsatile shock of the heart, and consequently the manner in which their enlargement is effected is very unlike that by which the arteries are dilated. Again, the veins are much more apt to contain puriform and other morbid matters than the arteries, both from a greater proneness, after slight injuries received, to take on and propagate the inflammatory action in a diffused form along their inner membrane; as well as from their connexion with the function of absorption, and their office of returning the blood from the various organs often the seat of disease. And farther, the blood coagulates much oftener, and more readily in the class of vessels which we are now considering, on account, probably, of its slower and more equable motion and its peculiarity of composition; and partly, it may be also, in consequence of a smaller supply of the nervous ramifications, and a lower degree of vitality in their coats,

* We refer particularly to the contributions of Baillie, Hodgson, Brodie, Meekel, Otto, Davis, Travers, Lawrence, Dance, Ribes, Breschet, Carmichael, Velpeau, Maréchal, Rochoux, Blandin, Bouillaud, Lee, Gendrin, Piorry, Louis, Cruveilhier, Carswell, Ward, and Andral. For a great proportion of the facts in the summary of venous pathology, here presented to the reader, we are indebted to the *Anatomie Pathologique* of the last-named author (vol. ii. sect. 3,) an invaluable work, which should early be put into the hands of every medical student.—AUTHOR.

as well as from their greater proneness to the effusion of coagulable lymph, and the more frequent presence of pus, either of which may constitute a nucleus for the commencement of the transformation.

The functional derangements of the veins which, in conformity with the arrangement we have hitherto adopted, should precede their inflammatory and organic changes, have been already in part noticed in previous portions of this treatise, when speaking of the preternatural pulsation of the jugulars and veins of the extremities, and the remittent humming sound heard in the neck, &c. A continuous buzzing sound has occasionally been perceived in this last situation, and also below the sternal ends of the clavicles, where an aneurism of the aorta presses on the venous trunks in the upper outlet of the chest—and any other tumour similarly placed would probably have the same effect.

The veins throughout the body are sometimes, moreover, in an unnaturally relaxed condition, their caliber being modified to an unusual degree by variations of temperature; and they are farther liable to be greatly over-distended, and even rendered varicose over the abdomen, legs, arms, &c., by the obstacle to the return of their blood which exists in cases of organic disease of the heart, or of pressure on any of their great trunks. But on these states, as being for the most part only symptomatic of disease in other parts, it is unnecessary here to dwell.

PHLEBITIS, OR INFLAMMATION OF VEINS.

Anatomical characters.—Secondary purulent deposits in organs.—Secondary organic inflammations and symptomatic fever.—Causes.—Phlegmasia alba dolens.—Treatment of phlebitis and phlegmasia dolens.

THERE has been the same difficulty in determining what anatomical proofs are to be admitted as decisive of the existence of phlebitis, as in the case of arteritis already treated of. The veins are even more prone to reddening by sanguineous imbibition than the arteries, both on account of their structure, and also of the greater quantity of blood generally contained in them in the moribund state, and after death. The hue thus imparted to them is, as we should expect from the colour of the blood within them, of a darker tint, and generally penetrates deeper, often entirely pervading their several tissues.

Anatomical characters. To establish indubitably the existence of venous inflammation, there must co-exist with redness of a lighter (more pinkish or browner) tint than that just spoken of, distinct vascular arborizations, or fine capillary injection in their walls, along with infiltration of their structure, the effusion of coagulable lymph or pus, or the existence of ulceration on one of their surfaces. The lymph so poured out may occupy either the exterior of the vessel, and so lead to its agglutination to surrounding parts, or else be poured out into the substance of its coats, or rather between them into the connecting cellular membrane, and so give rise to their morbid thickening; or finally, into its caliber, when, if in considerable quantity, it will necessarily obstruct the passage of the blood; or, if more thinly spread over its interior, it will assume the form of a false membrane lining its surface; and it is susceptible, under both these circumstances, of becoming at length organized into cellular tissue. It is thus that veins which have once been the seat of inflammation, are occasionally found converted into dense and impervious cords, whilst the office is supplied by collateral trunks in a state of preternatural dilatation. When the effusion is of a purulent nature, it may likewise exist in any of the three situations just indicated. If on the outer surface, the cellular membrane in which the vessel lies imbedded may

become the seat of extensive suppuration; when it takes place, on the contrary, into the cavity of the vein, it often co-exists with a coagulum of blood, by which the circulation through the vessel is stopped. The purulent matter is sometimes actually enveloped in the clot, and when thus situated has been supposed by Andral occasionally to originate within it, either by a process of transformation or of secretion; a supposition, however, which is still by many looked upon not only as merely hypothetical but unnecessary.

As to the pus so often found in the interior of the veins, it must be recollected that its source is frequently quite independent of inflammation of the coats of these vessels, being introduced into the torrent of the circulation either from ulcerated surfaces, or purulent deposits in other organs through which they pass, or from which they arise. Thus the veins returning the blood from an inflamed or cancerous uterus, from dysenteric ulcerations of the intestines, from a suppurating portion of the brain, from carious bones, or from joints or stumps in which the suppurative process is going forward, very frequently contain such matter.

In many instances the puriform matter, whether it be kept up by the veins in the ~~arteries~~ just indicated, or secreted from their lining membrane, or finally separated directly from the blood contaminated or altered in its constitution, is subsequently, as M. Dance, Rose, and others have shown, deposited in distant points of the system, as the serous cavities, the lungs, liver, spleen, joints, and cellular membrane, and more rarely in the kidneys, and even in the heart. The quantity of these deposits is probably, in some instances, still farther augmented by a process of suppuratory inflammation, excited by the presence of the pus, (or contaminated blood) in the capillaries of the organs to which it is carried, as the pain occasionally felt during life, and the softening redness or ulceration of the adjacent tissues, sometimes observed on dissection, seem sufficiently to evince.

The lungs and liver, and especially the former, are the organs into which these secondary purulent infiltrations most commonly take place. They usually present themselves in the form of deposits, varying in size from a pea to a walnut, or somewhat larger, disseminated through the structure of those viscera, which are generally unnaturally red in their immediate vicinity. They differ from ordinary abscesses in being neither encysted nor concentrated into one place. According to M. Dance, the affected portions present, in their earliest stage, the appearance of local sanguineous infiltrations; these subsequently have a very dark firm nucleus in their centre, which gradually becomes white and soft, and assumes all the characters of true pus. Whether the increased vascularity which surrounds these deposits is to be considered their cause or consequence, admits of dispute. M. Dance, like Mr. Arnott, is persuaded that whenever purulent deposits of this kind take place, phlebitis and an altered state of blood arising therefrom, have always preceded and led to them. Their occurrence in the liver, in connexion with injuries of the head (in which phlebitis, originating either in the injury done to the soft parts or to the bone, appears to be the connecting link,) had long ago attracted the attention of surgeons, but Morgagni had the merit of showing that the other viscera were not exempt from similar secondary disease in those cases.

Phlebitis is often attended with marked inflammation of the membranes of the brain; and in several instances the eye has been rapidly destroyed, the cornea becoming opaque and the whole globe red and swollen, and eventually bursting or becoming totally disorganized; several examples of this destruction of the eye in the puerperal state have been recorded by Dr. M. Hall and Mr. Higginbottom; and it has also been known to take place after the tying of the saphena, and after the inflammation and obliteration of the jugular vein.

An inflammatory condition of the organs from which the veins spring, or through which they make their way, become, not unfrequently, on the other hand, communicated to the coats of these vessels. This has been particularly observed, in respect to the cutaneous surfaces in which the local inflammation arising occasionally from even very slight injuries is, in certain states of the constitution, readily imparted to the lining membrane of the veins, and through their medium give rise

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to dangerous diffuse cellular inflammation. M. Ribes, in particular, speaks of having met with an inflammatory condition of the veins, characterized by redness, thickening of their coats, and a pseudo-membranous effusion lining their cavity, in cases both of simple and phlegmonous erysipelas; and Andral has noticed a similar appearance in the vena portæ, in connexion with disease of the liver and intestines.

Thus, then, it appears, inflammation of the veins may either be the cause or the consequence of inflammation in other organs; and from the rapidity with which the diseased action spreads along their inner coat, and the facility of transport or morbid products in these vessels, it is evident how important a part they must needs play in the propagation of diseases; and even their obstruction, though it may form a barrier against the farther transmission of the contaminating matters, becomes in its turn the source of a new set of evils, painful swelling of the parts beyond such obstruction, general dilatation of the collateral and subordinate veins, or even obliteration of many of the latter by the coagulation of the blood within them.

The local signs of phlebitis, when so superficially seated as to fall under the cognizance of our senses, are pain, greatly increased on pressure, swelling, stiffness, and occasionally redness, in the course of the vessel, generally extending upwards towards the heart in the direction of the current, more rarely spreading downwards, or in both directions. Where it has supervened on a wound in the vessel, as after the operation of venesection, a minute quantity of pus generally makes its appearance at the aperture; and after the inflammation has begun to abate, and the swelling at the surrounding cellular membrane has decreased, the indurated vessel may be felt rolling beneath the finger like a cord knotted at intervals.

The formation of matter is generally preceded by flying pains in different parts of the body, and accompanied by well-marked and repeated rigours.

The accompanying fever, especially in the advanced stage of the affection, is of a low or typhoid kind, characterized by great prostration, irritability, and anxiety, a very rapid pulse which soon becomes feeble and occasionally intermittent, hurried breathing, frequent nausea, meteorism, and tenderness of the abdomen, black sordes on the tongue and teeth, and muttering delirium, with a wild haggard look, and yellowish or discoloured skin. Such at least is a picture of the more aggravated cases as they draw towards their fatal termination. This form of fever, which bears a close resemblance to that induced by the injection of putrid matters into the veins, seem to occur especially in those cases where the purulent secretion becomes freely mingled with the blood so as to deeply alter its constitution, but doubtless may depend also in some degree in other cases on the rapid diffusion of the inflammatory process along the inner lining of the vessels. Mr. Arnott, however, has proved satisfactorily that the former is much the more influential cause of the two, for the worst general symptoms very frequently occur where but a very small portion of the vein is in an inflammatory condition. The larger the vein affected the greater is the danger, generally speaking, as the chances of its speedy obliteration and of the insulation of the purulent effusion and arrest of the inflammatory process are much less.

Causes. Phlebitis very rarely originates spontaneously, but may be almost invariably traced either to some injury done to the vessel itself, or else to the communication of inflammatory action from some contiguous tissue. Amongst its more ordinary causes may be enumerated all those operations in which veins of a certain magnitude are either wounded or tied, of which but too many examples presented themselves a few years ago, from the practice then prevalent of attempting to obliterate varicose veins by the knife or ligature. Instances of it are also not unfrequently afforded by the simple operation of venesection, especially where the lancet has been either blunt or dirty, or recently employed in operating on some diseased part, or where the incision having been made transversely, the orifice has long remained gaping or exposed to the air, or the limb been too freely used before

the wound has perfectly healed. The state of the health has also a marked influence in predisposing to the diseased action in question, and thus very slight injuries, which would have no ill effect in a healthy constitution, are often sufficient to induce this formidable disease in the irritable and unsound. Again, whether the suppurative or adhesive action shall predominate, and consequently the degree of danger attending the case, depend in a considerable degree on the previous state of the patient. It has appeared to M. Gruveilhier that operations or injuries affecting bones are peculiarly apt to be followed by venous inflammation. He has very often detected it after amputations in connexion with profuse suppuration within the shaft of the bone, and along with the purulent deposits in distant organs already spoken of; and remarks that a large proportion of the patients operated on in the Hôtel Dieu, are cut off more particularly by lobular pneumonia thus induced. The fatal erysipelatous inflammation of new-born infants seems occasionally to depend on suppuration within the umbilical vein, from the injury done to the cord after birth. Phlebitis is farther known to originate in exposure to cold, either by a current of air directed against the limbs, or by standing long in cold damp situations. An instance where gouty inflammation was transferred to the coats of a varicose vein is upon record. One of the most frequent of the causes of phlebitis is indubitably the existence of ulcers, either on the surface of the body or in its interior, as in the bowels, uterus, &c. We knew of an instance where the careless introduction of the pipe of an enema syringe, so as to injure a tumour seated within the rectum, gave rise to a general swelling of the lower extremity and well-grounded suspicions of the existence of inflammation of the femoral vein; and a French writer mentions a similar result from the introduction of a catheter into a diseased bladder. Pressure, if firm and long-continued, as by a tumour, a ligature round a limb, or other external cause, has likewise in many cases sufficed to induce inflammation in a subjacent vein, a circumstance the knowledge of which has been taken advantage of by Mr. Travers to effect the obliteration of varicose veins. Phlebitis in the superficial veins of the leg has ensued even upon a blow on the skin.

Phlegmasia alba dolens. Inflammation of the internal and external iliac and femoral veins has often been found to exist in puerperal cases, in connexion with the disease of the lower extremity, commonly known under the name of *Phlegmasia Alba Dolens*. This affection, which commences within from one to five weeks after delivery, is characterized by a very painful elastic swelling of the limb, which, though unnaturally hot and exquisitely tender, is of a pale colour, whitish and shining. Unlike ordinary œdema, it does not pit on pressure. From the stiffness of the part, and the impairment of the functions of its nerves, the power of motion is almost or altogether lost. The affected leg is often twice the size of the other, the swelling generally reaching its height within forty-eight hours from its commencement, and being for the most part preceded by rigors and a sense of uneasiness in the loins, lower part of the belly or groin, and more rarely by well-marked peritonitic symptoms.

Sometimes, but rarely, both limbs are affected, either successively or together. There is commonly much fever, a rapid pulse, with headach, thirst, foul tongue, and nausea. The acute stage is generally over in about a fortnight, but the limb often remains swollen and feeble for a length of time after, and we have seen it continue so for life along with painful varicosity of the superficial veins and great suffering from all prolonged exercise or standing. In a very few cases the patient has been cut off in the early stage by the violence of the accompanying general symptoms. This affection was described by Mauriceau so far back as the end of the seventeenth century; though, it is true, pathology is still litigated, and the theories which have been framed to account for its nature and origin are very various. Puzos and Leveret fancifully ascribed it, in consequence probably of its colour, to the translation of the milk to the limb; White, and Brandon Trye, to rupture of the lymphatics, or their obstruction by the pressure of the head of the fœtus against the brim of the pelvis; and Dr. Hull to a general inflammation

of the whole limb, its muscles, cellular membrane, and inferior surface of the true skin, and occasionally extending even to its great vessels, along with a rapid effusion of serum and coagulable lymph into the sub-cutaneous cellular tissue. Dr. Davis, M. Bouillaud, and Dr. R. Lee, have endeavoured to show that the affection is altogether dependent on phlebitis, asserting that the iliac and femoral veins are invariably found, either containing pus, or thickened and contracted, or plugged up by a coagulum of blood, or by plastic lymph; and the last-named author believes farther, that the inflammatory action is always imparted to the veins in question, by the uterine vessels in a similar state. According to M. Dance likewise, phlebitis has very often its origin in inflammation of the uterus after delivery; but Velpeau supposes it to commence rather in suppurative inflammation of the pelvic articulations, and the subsequent introduction of pus from this source into the veins by absorption. Many pathologists, however, are still averse, and we think with reason, to ascribing such an exclusive influence to the veins in the production of the swelled leg of lying-in women, believing that they are only implicated in common with, or even subsequently to several other tissues, more especially the sub-cutaneous cellular membrane, the inferior surface of the cutis vera and the superficial nerves; for the swelling here, unlike that induced by the ligature of a vein, most frequently begins in the groin, labium, and thigh, and afterwards spreads downwards, in place of always manifesting itself first in the distal extremity of the limb, and it is accompanied, moreover, by an acute neuralgic tenderness diffused over the whole surface, and not met with in the same degree in cases of pure phlebitis, in which the pain and sensibility to pressure are more localized in the course of the vessels. Again, in *phlegmasia dolens* the swelling is not œdematous, but from the quantity of coagulable lymph poured out it is tense and elastic, and when the disease is fully formed rises immediately after pressure, and cannot be evacuated in almost any degree by puncture or incision; and finally, the type of the accompanying fever is very dissimilar to that in indisputable phlebitis, and the rate of mortality is incomparably lower.*

An affection of the lower extremities, somewhat similar to *phlegmasia dolens*, has been occasionally noticed after abortion, and likewise in connexion with cancerous ulceration of the uterus, or after the removal of polypus from that organ, in elderly women,† and even in individuals of the male sex an analogous swelling of the limb has sometimes presented itself when individuals were labouring under inflammatory or organic diseases of the organs within the pelvis, as the rectum or bladder. Thus, Dr. Charles Forbes and Mr. Holberton have each recorded an instance of its occurrence in young men in the advanced stage of phthisis, where it probably had its source in ulceration of the large intestines, and to the communication of the inflammatory action to the veins.

To Dr. Tweedie the merit is due of fixing the attention of practitioners on an inflammatory and very painful swelling of the limb, occurring in or after fevers.‡ It had previously been cursorily alluded to by Dr. Cheyne, of Dublin, and similar instances have been recorded more recently by Drs. Graves and Stokes.§ It differs, as Dr. Treedie has pointed out, from the passive œdema of the lower extremities, also occasionally one of the sequelæ of protracted fever, in being ushered in by rigors and renewed febrile symptoms, in generally attacking but one leg, which becomes exquisitely tender, and in commencing commonly in the upper part of the thigh and thence extending downwards, and in not retaining the impression of the finger. The swelling, like that in the puerperal state, is colourless.

* See Dr. Johnson, in No. XXII. of the *Medico-Chirurgical Journal*, and in previous numbers; also Dr. Graves's *Lectures*.

† Lawrence, in *Medico-Chirurgical Transactions*, vol. xvi.

‡ Ed. Med. and Surg. Journ. vol. xxx. p. 258.

§ The earliest notice of it we have met with is Mr. Bellot's case, as detailed by himself in *Ferrier's Medical Histories and Reflections*, vol. iii. p. 187.

The superficial cutaneous veins are occasionally much dilated,* and the power of moving the limb almost totally lost. It has been viewed by the author just named as an acute inflammation of the cellular tissue, demanding very active local antiphlogistic treatment. It has, though very rarely, gone on to suppuration, and is occasionally, as remarked by Drs. Graves and Stokes, complicated with inflammation of the cavities of the joints. A similar swelling has also been noticed in the upper extremity, in conjunction with intense pain and inflammation in the cellular tissue about the breast.

Treatment of phlebitis. From the state of depression which commonly exists, general blood-letting is rarely admissible. The free and repeated application of leeches over the inflamed portion of the vein constitutes the chief part of the treatment, with which the use of mild aperients and diaphoretics is to be combined, and, in severe cases, the antiphlogistic influence of calomel in combination with opium or antimony, or both, ought early to be had recourse to; digitalis has likewise been recommended, but it is of such more dubious efficacy.

The affected part should be placed in the position most favourable to the return of its blood, and an emollient cataplasm applied; or if more agreeable to the patient's feelings, an evaporating lotion, or water dressings, may be substituted. The local vapour bath, which has found recently so able an advocate in Dr. Macartney, would seem, from its soothing and relaxing influence, and from leaving the part free from all pressure, peculiarly suited to these cases.

The proposal of Mr. Hunter to effect the obliteration of the vein by means of pressure with firmly-applied compresses above the point of inflammation, has not, we believe, been generally successful, though it is still occasionally practised in France with another view, that of preventing the passage of the purulent matter into the general current of the circulation.

Where there is great sinking, bark, wine, and diffusible stimulants, together with beef tea, jelly, and other light nutriment may be requisite, even while the local depletory treatment already recommended is being put in practice.

In *phlegmasia dolens*, no less than in pure phlebitis, the early and frequent topical abstraction of blood, by the application of leeches in large numbers (20 to 40,) over the femoral vein, as it passes from underneath Poupart's ligament and along the inside of the thigh, is the leading indication, along with which assiduous fomentations are generally advantageously combined, though to some patients cooling applications are more soothing. From the known influence of mercurial ointment in moderating erysipelatous inflammation, its trial has been recommended also in phlebitis, and in the acute cellular inflammation so often connected therewith; and in consequence of the morbid state of sensibility of the cutaneous nerves which marks phlegmasia dolens, and the peculiar inflammatory swellings of the limbs after fever, Dr. Graves has been led to combine it with one-eighth part of the extract of belladonna, applying them on lint over the whole extent of the limb, whilst he, at the same time, freely exhibits opium internally (iv to vi grains in the twenty-four hours,) or Dover's powder, and endeavours to promote the secretions and slightly to affect the system by the Hydrarg. cum Cretâ given thrice a-day.

When the disease in the limb has passed into the chronic or indolent state, blisters, frictions, and bandaging are to be had recourse to, in order to promote the absorption of the remaining swelling.

* The distention of all the minute cutaneous veins was probably the source of the bluish tinge of the skin, in a case of phlegmasia dolens recorded by Dr. Stokes—AUTHOR.

VARICOSE VEINS.

Causes, effects, and treatment.

THE irregular knotty enlargement to which the veins, especially the more superficial ones, which are least supported by external pressure, are liable, may originate in any permanent obstruction in their course, whether from inflammation in the vein itself or pressure on its outer surface; as, for instance, by the gravid uterus, a diseased liver, indurated glands, aneurismal tumours, &c., or, if more general over the body, in obstacle to the passage of the blood through the heart or lungs, or in universal relaxation of the coats of these vessels.

The veins arising from a cancerous part, or one in a state of chronic inflammation, are usually much dilated, and the appearance so produced forms an important feature in the external physiognomy of such morbid states. Obliteration of the deeper-seated veins by inflammation of their parietes, by tumours, malignant diseases, &c., give rise to an unnaturally swollen and prominent condition of those near the surface, and thus a valuable indication of disease in internal organs, out of the reach of immediate examination, is occasionally afforded.—Thus, for instance, in obliteration of the superior cava, as has been remarked by Reynaud, the intercostal and mammary veins are seen dilated and freely anastomizing with those from the head; whilst, if the cava inferior, or vena portæ, is obstructed, the epigastric and external abdominal veins are greatly enlarged. The vena cava, azygos, and other internal veins have occasionally been found in a varicose state. A similar condition of the jugulars in the neighbourhood of the clavicles has sometimes, on insufficient examination, led to an erroneous suspicion of arterial aneurism.

Varix was supposed by Mr. Hodgson to be connected with rupture of the valves of the veins, but this opinion has not been borne out by later anatomical examination. (*Stanley.*) Where, however, the dilatation is already considerable, the valves will obviously no longer be capable of fulfilling their natural office of preventing the retrograde motion of the blood, and the ill consequences of their diseased state must then necessarily be much augmented. When varices of the legs are very large, the assumption of the erect posture has been known to give rise to fainting, in consequence of the sudden withdrawal of so large a quantity of blood from the centre of the circulation and from the brain, as was exemplified in a case recorded in Lower's work on the heart.

The enlargement of the caliber of the veins may be accompanied either by thickening or thinning of their parietes, or by both states at different points. The dilatation may either take place pretty equably throughout a considerable extent of their tube, which acquires, moreover, a tortuous outline from the simultaneous elongation of the vessel, or else may present here and there sacculated protuberances, or may be divided into loculi by septa crossing their interior: and farther, these cells occasionally communicate by numerous small apertures with the surrounding cellular membrane, a state of things analogous in some degree, as Andral has remarked, to the natural structure of the spleen, and which is not unfrequently found in hæmorrhoidal swellings, though these may also consist in the simple dilatation of one or more veins.

A spontaneous cure of varicose veins, especially the sacculated variety, has occasionally been effected by the supervention of a slight inflammatory action in their walls, the effusion of lymph, the coagulation of the contained blood, and the consequent obliteration of their caliber. Varicosity of the veins necessarily gives

rise to serious obstacle to the return of blood, and, consequently, to œdematous swelling, weight, numbness of the parts from which they arise, to inaptitude for active exercise, tendency to chronic inflammation in their coats, and to bursting of the vessel at its most prominent part, and hence to serious or even fatal hæmorrhage, as well as to very obstinate sores on the extremities.

Treatment of varicose veins. The palliative treatment has now almost entirely superseded the attempt at radically curing the disease by ligature, or cutting across, or excising a portion of the vessel, as practised a few years ago at so much risk even of life. Where the varicosity exists in the lower extremities, incomparably its most frequent seat, the person should avoid walking much, and still more standing long at a time; the limbs, when at rest, being kept in the horizontal posture, and the vessels at all times supported by elastic bandages, or laced stockings.

Where a sub-inflammatory state of the vein, or surrounding cellular membrane, has been accidentally induced, leeches and evaporating lotions, with aperients, a cooling diet, and perfect rest, will commonly afford speedy relief. Indeed, the importance of a temperate and rather dry diet, with a view to keeping the quantity of the circulating fluid moderate, along with attention to whatever may serve to improve the tone of the system generally, and consequently, also, in some degree, that of the diseased vessels, and the promotion of a due performance of the excretory functions, are, in a chronic disorder like this which rarely admits of a perfect cure, obviously points of the first importance.

When sudden hæmorrhage occurs, the person must instantly be placed in the horizontal posture, and a compress and bandage applied over and *below* the aperture, so as to arrest the farther escape of the returning blood. When ulceration ensues, the water dressing, or black wash (calomel and lime-water,) covered with oiled silk to prevent evaporation, and retained by an evenly applied bandage continued from the foot upwards, form the best local applications. Where there is much thickening of the coats of the vein the tincture of iodine has been employed by Mr. Guthrie with advantage.

Mr. Mayo is still an advocate for obliteration of the vein, by the formation with caustic of a narrow transverse eschar of the integuments across its course, by means of which the adhesive inflammation is excited in its coats, and for the most part, according to his experience, without any serious accidents. Some other practitioners prefer having recourse to the effects of pressure by means of any hard substance firmly retained for some days, by tightly drawn adhesive plaster, or bandage, along the trajet of the vein. We apprehend that the cases where either of these proceedings will effect a complete and permanent cure are rare, seeing that so many branches are commonly implicated, and that there is usually a marked tendency to the recurrence of the disorder. A plan which has recently been employed by Mr. Colles with considerable success, and which has the advantage of being unattended with danger, is to make permanent but moderate pressure on the saphena, where it is about to enter the femoral vein, by means of a spring compress so applied as to diminish the ordinary flow of blood through the superficial veins, and compel the deeper seated ones to a supplementary action.

In varix of the scrotum Mr. Wormwald has succeeded in affording relief, by drawing the lower portion of the skin through a metal ring, so as to reduce the quantity of blood circulating in the part; whilst M. Breschet advocates the more hazardous practice of obliterating the varicose veins, whether in the cord or scrotum, by the graduated pressure of a screw forceps, which soon produces an eschar at the point of application, and adhesive inflammation of the walls of the vessel and consequent obstruction of its canal.

MISCELLANEOUS AFFECTIONS OF THE VEINS.

Spontaneous perforation and laceration of the veins and of their valves.—Obliteration of their cavity.—Calcareous deposits.—Phlebolites,—Fatty tumours.—Gaseous effusions.

THE veins, in addition to the lesions already alluded to, are farther liable to *perforation*, with or without previous ulceration, softening, or wasting of their coats. The vena cava has been known to be burst or lacerated during violent muscular struggles and falls from a height. A similar event is said to have occurred in the rigors of an ague, and in a delicate female, mentioned by Portal, under the action of the cold bath. Large veins are occasionally penetrated from without inwards by the spreading of malignant ulcerations from adjacent parts.

The *valves* of the veins likewise are sometimes found *lacerated* or *perforated*, and when, in this state, they are often entangled in their fragments shreds of coagulated blood and of lymph—appearances for the most part indicative of previous inflammation of the lining membrane.

Independent of their obstruction by an inflammatory tumefaction of their coats, effusion of lymph, and coagulation of the blood within them, the veins are farther exposed to *obliteration* by the pressure of contiguous aneurisms and other tumours against their external surface. Their obstruction, however induced, is the usual source of partial dropsies, as one of the limbs, abdomen, the side of the face, &c., as Bouillaud has ably demonstrated several years since.

Calcareous depositions are occasionally, though rarely, met with in the walls of the veins, and there is reason to believe that a pre-disposition to their formation is, sometimes at least, the consequence of previous inflammation. Both Morgagni and Baillie had seen them in the vena cava; Bécларd in the femoral vein, when in contact with the corresponding artery, which was in an ossified state; and Dr. Macartney and Andral in the external saphena. The last-named author speaks of instances in which concretions of this kind, formed in the walls of the vessel, push the lining membrane before them, and thus project into the cavity, attached at length only by a narrow pedicle; and he suggests the possibility of the *phlebolites*, or loose pisiform, or oval concretions occasionally found within the veins, varying in size from a grain of millet to a pea, having their origin in this manner by the eventual separation of the slight remaining adherence. He suggests that they may also occasionally have their source in the coagulation of the blood and subsequent vital processes carried on within the clot; an opinion which has likewise been advocated with his usual ability by Dr. Carswell, as well as by Tiedemann, Otto, and Errhman. A small coagulum first forms, and in the centre of it appears a firm nucleus with concentric layers. This becomes gradually denser, the red part of the blood being absorbed, and calcareous matter deposited in the interior, till all the lamellæ have at length undergone the ossific change. The most frequent seat of these concretions appear to be the veins of the pelvic viscera, and the sub-cutaneous ones of the lower extremities.

Fatty tumours have been met with in the walls of the veins projecting into, and nearly obliterating their passage; and Andral speaks of having, in one instance, detected hydatids within the pulmonary veins of a man who had died of organic disease of the heart, but was not aware of any similar case on record in the human subject. In horses, however, and others of the lower animals, the occurrence of various species of *entozoa* within the blood-vessels is by no means very rare.

There is reason to believe that *gaseous matters* have been secreted in some very rare cases into the cavity of the blood-vessels during life, or else that they have separated spontaneously from the blood in a morbid state.* The vast majority of instances, however, in which such products are discovered on dissection, have their source in incipient putrefaction.

* See Dr. Mollan, in *Dublin Hospital Reports*, vol. ii. p. 329, and Dr. Reid, in the *Transactions of the King and Queen's College of Physicians*, vol. v. For examples of the secretion of air into the cellular membrane and serous sacs, see Valsalva, Ruysch, Frank, Laennec, Andral, Rebolle de Gex, and other authorities cited by Dr. Graves, in the twelfth number of the *Dublin Medical Journal*.—AUTHOR.

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